SCIENTIFIC AMERICAN

The Monthly Journal of Practical Information

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SLIPPING THE ROTOR IN PLACE: THE ASSEMBLING OF A HUGE TURBO-GENERATOR UNIT.—[See page 17]

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This statement, made recently by a big fleet-owner, indicates how highly Kelly Kats are regarded by truck owners who know various types of tires.

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2nd Saving Considerable time is saved by eliminating shutdowns for replacing or adjusting bearings; forced idleness of machines and men is a cost-factor too big to be ignored.

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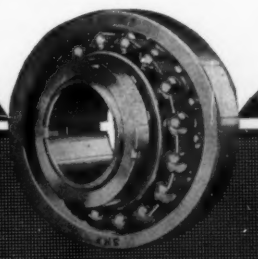
4th Saving There is no discernible wear of the hard steel balls and races and absolutely no shaft wear. Dust and grit cannot enter the bearings and Skayef self-aligning ball-bearings have the exclusive inherent ability of compensating automatically for shaft deflections.



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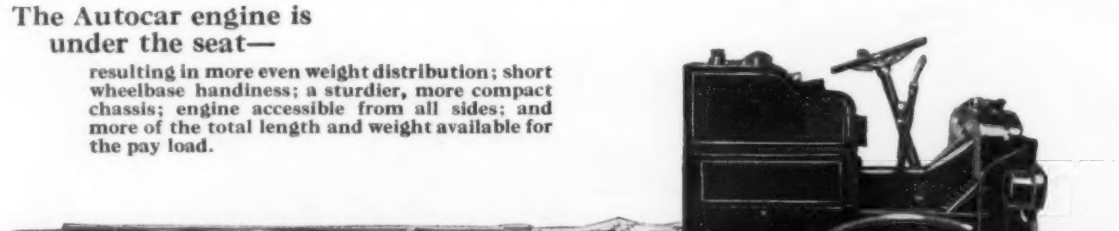
The Autocar engine is under the seat—

resulting in more even weight distribution; short wheelbase handiness; a sturdier, more compact chassis; engine accessible from all sides; and more of the total length and weight available for the pay load.



The sturdy 4-cylinder Autocar

Distinctive Autocar short wheelbase handiness

Saves time in traffic

Permits turning without backing in average street

Makes deliveries easy in seemingly inaccessible places

Saves gasoline by reducing jockeying

Saves time inside industrial plants

Delivers construction materials right where they will be used

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ESTABLISHED 1897

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gas *and* electric trucks

EITHER OR BOTH – AS YOUR WORK REQUIRES

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With the Editors

FROM far-away Alaska comes a letter which we would quote. It is signed by Rev. John W. Chapman, in charge of the Christ Church Mission, Anvik. Anvik is 300 miles up the Yukon, in a peculiarly inaccessible location. Dr. Chapman writes: "You may remember having given encouragement to a radio foundling, less than a year ago. I am glad to be able to report that the infant began to walk alone last night, when messages were exchanged with WUY at Holy Cross. It is a great satisfaction to us, that we are now in two-way communication with all the world. Our clocks are regulated today, by time signals caught last night. 'Radio for Everybody' put us on the track." Any comment which we might make upon this letter is superfluous; Dr. Chapman has said it for us.

IT so happens that "Radio for Everybody" is a SCIENTIFIC AMERICAN book which has met with a phenomenal success. Originally intended as a guide book for the beginner in radio, this book has become a text book in several schools and colleges as well as in the United States Navy. The first edition appeared in March, 1922, shortly after the birth of radio broadcasting. In an effort to keep up with the demand for the latest available information on popularized radio, this book has been revised several times and reprinted no less than eight times. Recently, however, the revisions became so heavy, due to the unrelenting progress of radio broadcasting, that it was found necessary to rewrite the entire work from start to finish. The rewritten edition of "Radio for Everybody" will shortly be off the press.

IT is in order at this time that we say a word regarding the SCIENTIFIC AMERICAN books, for after all they are part of the SCIENTIFIC AMERICAN service to our large family of readers. These books are generally in the form of supplementary reading, representing, as they often do, the occasional overflow from our columns. Thus the subject of radio has been covered in a general way in the columns of the SCIENTIFIC AMERICAN; but the demand for the involved theories and specific details of radio has had to be met in a supplementary publication devoted entirely to that subject. The same may be said for the home-building field; numerous general articles on the various phases of home-building have appeared in this journal from time to time, but the demand for specific details has been met in our supplementary publication, "Scientific American Home Owners' Handbook." The full account of Mr. Bird's psychic adventures, together with his lengthy notations, has overflowed the space limitations of this journal and gone into "My Psychic Adventures." And there are many other cases of a similar order.

ALL these supplementary publications as well as any and every book dealing with one or the other field of technology, is available to you through our Book Department. Our aim to serve would not be attained were we not prepared to supply you with additional information on any subject in which you may be particularly interested. So, if you are in search of knowledge of one form or another, just place your problems before us. Or again, if you have suggestions for new books or even manuscript, please do not hesitate to submit them to our Book Department.

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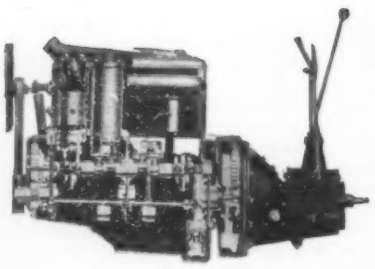
ANOTHER letter which we shall quote, this time anonymously, comes to us from one of the best known of American astronomers. We had planned to ornament Mr. Barringer's story on page 10 with an editorial "box," estimating the place which this contribution should be given in the scientific literature of the day. Our unnamed correspondent does this so well that we can find no words better than his, and we accordingly give them substantially verbatim in the next paragraph, adopting them as our own.

IT has for some time been practically settled that Meteor Crater in Arizona is due to the impact of a large meteoric object. Barringer had done very good work in furnishing data on this subject. (The editor might remark here, on his own responsibility, that Barringer has positive proof beyond anything that has been published.) When he attempts, however, to revive Proctor's old theory that the lunar craters are similarly produced, he goes beyond his evidence, in the judgment of most authorities. Several geologists will agree with him, but the astronomers who have seen the moon under the most favorable circumstances are practically a unit against him.

SO much for our anonymously abstracted authority. Speaking now strictly in the capacity of the editorial We, we would remark that Mr. Barringer presents the arguments for his theory better than we have seen them marshalled by any of his predecessors in its expounding. We believe he makes more of the impact theory than has ever been made of it before—else we had not given him space to make anything out of it, interesting as his paper is. Those readers who wish to consider the evidence fully from both sides may be referred, for the other side, to "Lunar and Hawaiian Physical Features," Memoirs Amer. Acad., 1906; and to "Origins of the Lunar Formations," Publications Astron. Socy. Pacific, 1920. It is our own judgment, as well as that of several scientists of distinction in various fields to whom Mr. Barringer has submitted his paper, that he brings up points which must be disposed of before the theory of volcanic origin of the lunar craters can settle back into unquestioned dominance of the field.

THE research laboratory is a feature of modern industry that has come to stay. The big corporations are thoroughly sold on the proposition that it pays for itself; and this is so regardless of whether, as with the tungsten filament and the gas-filled lamp, the results are of obvious patentability and immediate commercial value, or whether, as in the case of the researches of a Langmuir into the structure of the atom or those of a Mees into the nature of light, they are merely an addition to our fund of theoretic knowledge. Schenectady and Rochester are first brought to mind by the names and achievements just mentioned; but Lynn boasts of a research laboratory, sister to the one at Schenectady, which now comes forward with a discovery that might fairly be estimated as having greater potential meaning to all the industries and all the scientists than any other research achievement of recent years. We went to Lynn and got this story, and in this issue it is yours. You will find it on page 6; and whatever your business or profession, you will find in it some suggestion for better tools or better technique.

Announcing the FEDERAL-KNIGHT MOTOR TRUCK



The Federal-Knight is powered with a Famous Knight Engine

The simplicity and efficiency of this sleeve-valve engine have been amply demonstrated in this country and abroad. The Willys-Knight engine, by reason of its design, will take greater punishment and stand greater strains than any other type of engine. It actually improves with use and increases in power from continued operation. Its flexibility and economy are unquestioned.

The Federal-Knight establishes new and long striven for dependability and economy in light, delivery type motor trucks.

Designed by Federal engineers with a successful experience of many years in highway transportation—with a strength and ruggedness of parts unusual in this kind of truck—and with the marvelous Willys-Knight sleeve-valve engine—this Federal-Knight is indeed a wonderful performer.

Economy and long life—quietness of operation—ease of control with responsive acceleration under load—hill climbing ability—a minimum of mechanical attention—all these and many more features are assured the truck operator with this Federal-Knight.

Investigate the Federal-Knight Truck Now. Write for Descriptive Folder and see it at the showroom of the nearest Federal Dealer.

$1095

At this amazing price the FEDERAL-KNIGHT is the lowest priced truck of its type manufactured today. If you will compare it part for part with other light trucks you will further realize its remarkable value. $1095 for chassis only in lead. F.O.B. Detroit. Excise tax additional.

The Federal-Knight Express—with flare board Express Body

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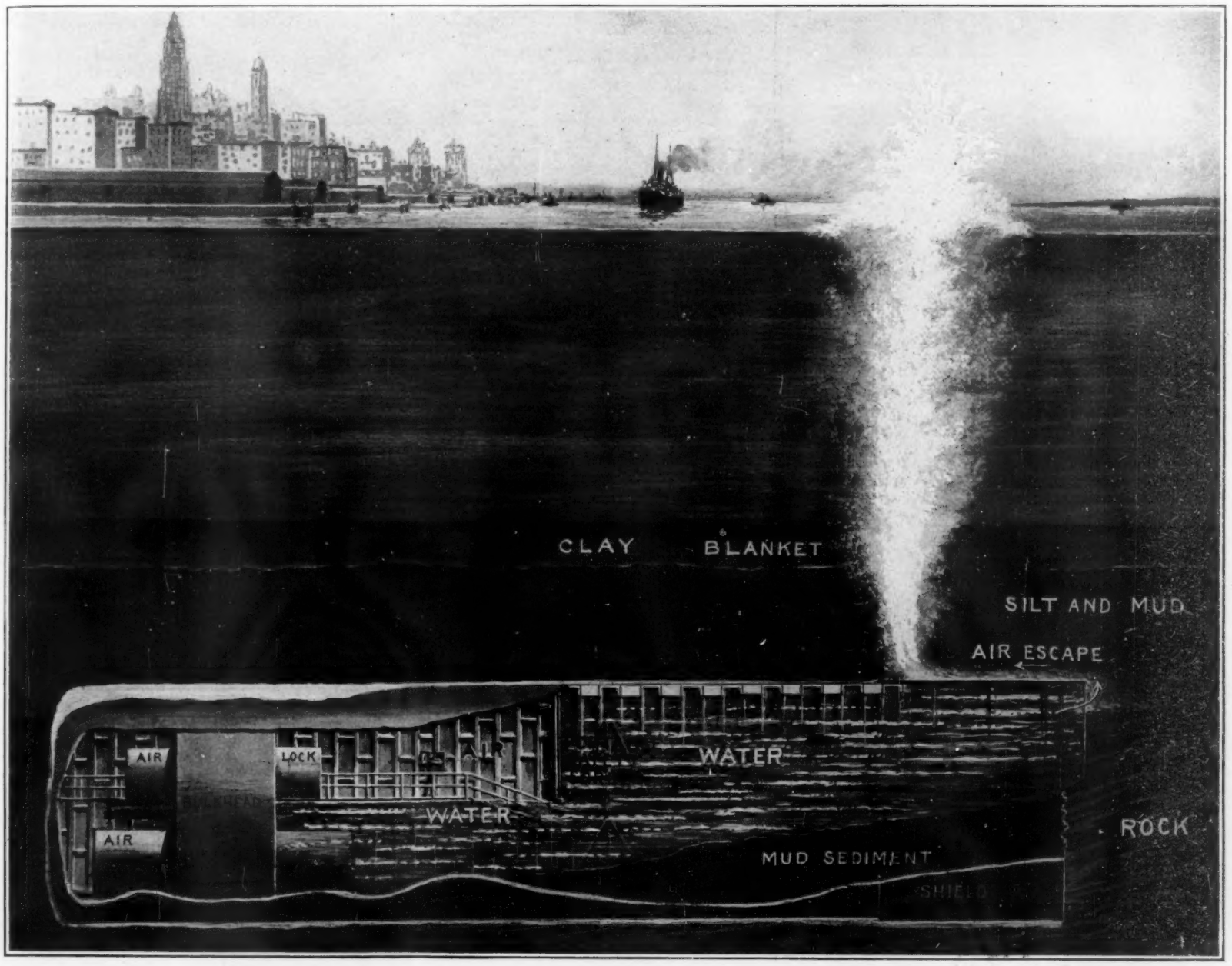
EIGHTIETH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JULY, 1924

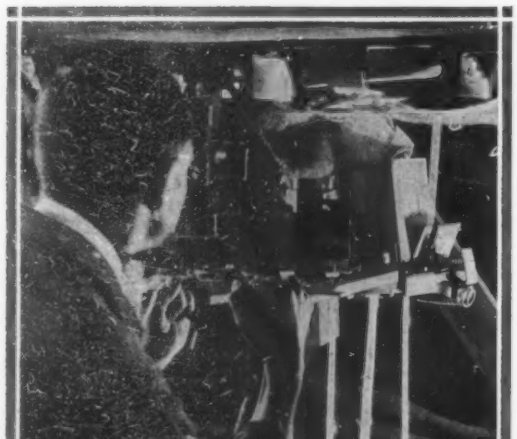


DURING a recent blowout in the Hudson Tunnel tube, when there was a sudden inflow of silt and water into the tunnel, the safety screen served its purpose well. The two tubes, 30 feet in diameter, are being driven through the river mud by the compressed air method, the inward pressure of the plastic mud being counterbalanced by the outward air pressure against the mud. The tunnel is excavated by means of a massive steel shield or cap, which covers its forward end and extends several feet back over the completed portion of the tunnel, around which it fits with a few inches clearance. The shield is advanced by powerful hydraulic jacks which thrust it bodily through the yielding mud.

The blowout was caused by the compressed air forcing its way back between the tunnel lining and the shield and escaping at the rear of the shield. At this point the mud was unusually soft. Under the action of the air it was churned up and thrown into suspension, and the air broke through. This was accompanied by an inflow of water to the tube, where it steadily rose, driving the men to shelter. To meet such an emergency, there is a bulkhead, extending from the roof and covering the upper half of the tube. The water can rise to the bottom of the bulkhead, but is restrained at that level by the air pressure. When the blowout occurred, the men had only to run back to this shelter, from which they could escape through the airlock. The mishap was remedied by dumping a few bargeloads of stiff clay above the tube.

The air pressure required within the tube is determined by the pressure against the outside of the tube due to the load of mud and water above it. For a given depth of the tube below water level, the pressure will be determined by the depth of the mud, since the mud weighs, say, 100 pounds, and the water 62.4 pounds, per cubic foot. The depth of the water and therefore of the mud is determined by soundings, and the necessary air pressure determined accordingly. An undetected shallowing of the mud would reduce the load on the tube and here equilibrium being destroyed, the air would break through.

HOW AN EMERGENCY SCREEN SAVED LIFE IN HUDSON TUNNEL BLOWOUT



Rod of quartz emerging from electric furnace and being cut to length

A New Miracle Mineral

Our Recently Acquired Ability to Fuse Quartz in Quantity, and What This Means to Industry and Science

PLATINUM has for many years figured as the "miracle metal": the material which we should prefer to use for most purposes if only we had complete freedom of choice. Low expansion, high melting point, extreme hardness, easy workability, great mechanical strength, favorable chemical and electrical properties—these are the virtues of platinum. But it is one of the most expensive of all raw materials; and this is due, not to inordinate expense in its production, but to its sheer and inescapable rarity. There isn't, in the earth's entire crust, a tithe of the platinum which we should require if we were to use it for all the purposes for which it has always been the most desirable material.

What shall we say, then, when the rôle of platinum as miracle material is usurped by a substance which is the most common of all minerals? What shall we say when told that this material has far less expansion than platinum, and a higher melting point? A hardness exceeding platinum's, and electrical properties different from those of the metal but none the less valuable? A chemical inertness equal to platinum's, and insulating properties more remarkable than platinum's conductivity? And what shall our reactions be when, on top of all this, is piled the climacteric fact that this miracle mineral is more transparent, alike in degree and in kind, than the best glass?

The wonderful substance thus characterized is a very familiar friend. It is quartz: rock crystal, silicon dioxide, silica, SiO_2. In crystal and amorphous and granular forms it is the commonest constituent of the earth's crust—the supply is literally inexhaustible. We have always known its properties, but we have never applied them on any scale, because the melting point of quartz is so high, and its hardness so extreme, and its general persistence in the form in which it happens to be so strong, that we haven't ever been able to manufacture it save at inordinate expense.

It would be perhaps a bit enthusiastic to say that this problem has been solved: that a *cheap* way of treating quartz has been found. But it would be entirely within the facts to say that *a way* of treating it in quantity has been found, so much *cheaper* than the old way that it is now possible to use quartz wherever quality is the prime consideration, and price only a secondary one. Up to now, lenses and tubes and other shapes of quartz could be made only by a process of hand working in the oxygen flame—a process of blowing beside which the ordinary labors of the glass-blower are child's play. Shapes of fused quartz have been worth several times their weight in gold; today it is possible for the manufacturer to give away cigarette holders as souvenirs to a fairly large company of guests. Production is promised by the big factory in Lynn, Mass., at an early date and in sufficient quantity to make the material available wherever it is needed most. Obviously the solution of the problem is a permanent one; unlike the case with platinum, there can never be difficulties with the supply of raw material.

The outstanding merit of "clear fused quartz," as the new material will be called, is its vanishing coefficient of expansion. It expands only one thirty-fourth as much as copper; one-seventeenth as much as platinum. Invar, named in honor of its infinitesimal expansion, fairly swells up and bursts open under the application of heat, as compared with quartz. A quartz rod one foot long, heated through 1800 degrees Fahrenheit, will lengthen only seven one-thousandths of an inch.

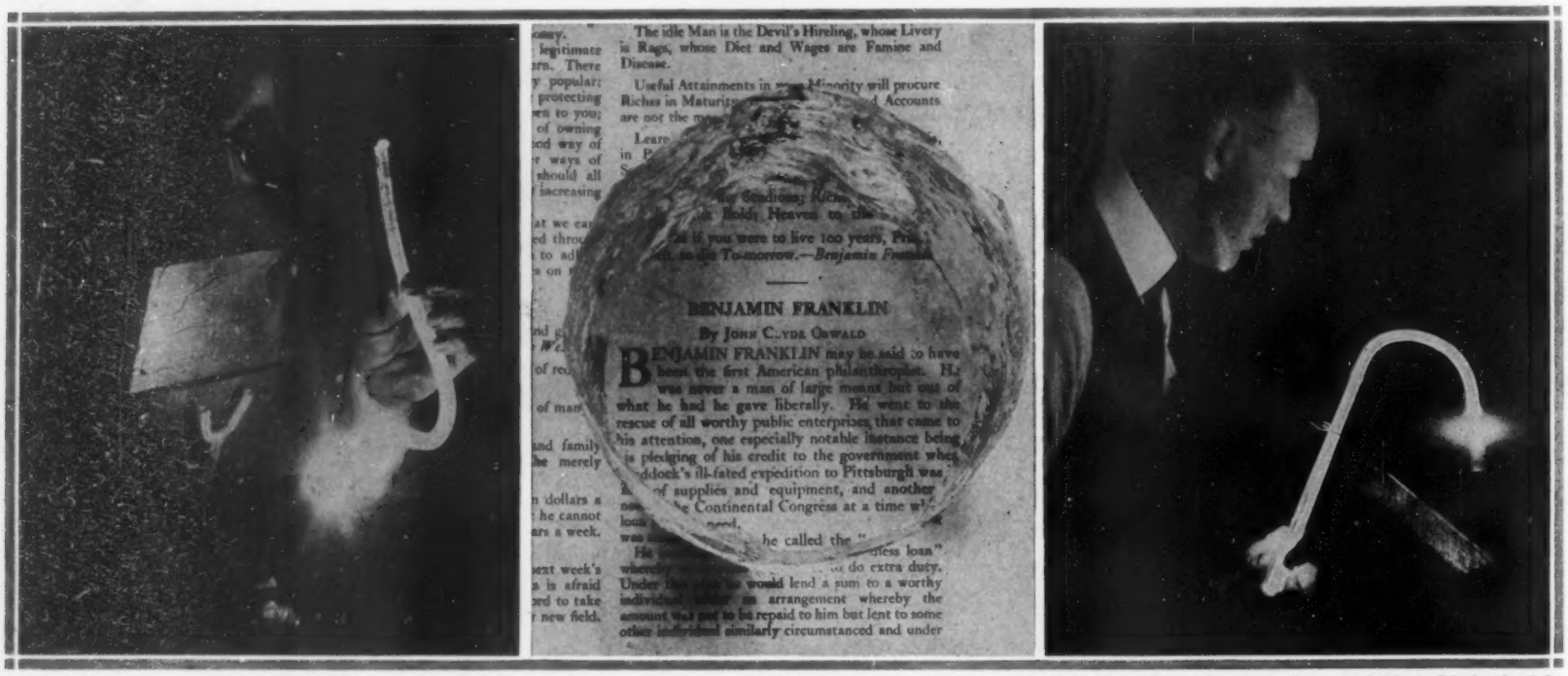
This opens up a wide vista in two directions. Articles of quartz will retain their size and shape, and hence their precision qualities, under repeated heating and cooling, far better than of any other known substance; and quartz shapes under application of *extreme* heat, will fracture far less freely than any other material ever known or dreamed of. A thin quartz tube can be heated above the melting point of gold and practically to its own melting point, then plunged instantly into cold water—without damage! At the Lynn demonstration a few weeks ago a quartz tube was tested against one of the fire-resistant glass which has come into such deservedly wide use of recent years. It is no discredit at all to this product that, when heated to 3000 degrees and plunged into cold water, it simply exploded; yet a quartz tube of the same figure, heated to nearly 4000 degrees, came up smiling after its cold bath, without a crack!

After its utter indifference to extreme heat and rapid change of temperature, the important property of clear fused quartz is its transparency. In the visible spectrum, it transmits 92 per cent of the energy that falls upon it; the very best optical glass 55 per cent; glass of the common or garden variety 35 per cent. And when we come to the ultraviolet, to which all glass is practically opaque, quartz is practically 100 per cent transparent. It transmits the entire spectral range, from the longest infra-red to the shortest ultraviolet.

An extremely neat demonstration of the transparency of quartz is made possible through another of its properties. Given half a chance, it tends to form a remarkably smooth surface. The rods formed in ordinary course of manufacture by the newly developed process have such a surface; they act as perfect mirrors, both for light reached them from without and for light from within. Hence, if light be introduced into one end of such a rod, it can no more get out than water can get out of a pipe, but is reflected back and forth inside the rod until it reaches the other end. Here it encounters a rough surface through which it can escape. The consequence is that if one end of the rod be presented to a source of light, the other end will shoot the rays into the air; and this property persists even though the rod be curved. Not only can light thus be made to turn a corner for exhibition purposes, but the trick is of actual utility in introducing light into an inaccessible place. The mere flicker of a burning match will be thus transmitted through a tube twenty or twenty-five feet long, whereas such a thickness of ordinary glass would be totally opaque. This is a demonstration that never fails to bring applause from an unsophisticated audience, and that gains high appreciation even from a sophisticated one.

An amusing variation arises when heat rays take the place of the visible ones. You can hold one end of a quartz rod in a high-temperature flame, grasping the rod in the middle and holding it indefinitely without discomfort. If I grab the other end, however, I shall get a handsome burn from the heat transmitted along the rod!

Fused quartz is also the most perfectly elastic substance known. If a rod or tube of it is bent or twisted out of shape (always within its fracturing limits) it will return exactly to its former state, no matter how


The idle Man is the Devil's Hireling, whose Livery
is Rags, whose Diet and Wages are Famine and
Disease.
BENJAMIN FRANKLIN
By John C. Van Dyke
BENJAMIN FRANKLIN may be said to have
been the first American philanthropist. He
was never a man of large means but out of
what he had he gave liberally. He went to the
rescue of all worthy public enterprises that came to
his attention, one especially notable instance being
is pledging of his credit to the government when
ddock's ill-fated expedition to Pittsburgh was
of supplies and equipment, and another
e Continental Congress at a time w
need.
he called the "
do extra duty.
Under
would lend a sum to a worthy
individual
arrangement whereby the
amount was not to be repaid to him but lent to some
other individual similarly circumstanced and under

Left: One end of quartz rod in the oxygen flame, showing light transmitted. *Center:* Demonstrating the transparency of quartz. *Right:* Another exhibit: the news print was plainly legible by the light transmitted along the rod

Three examples of the remarkable transparency and allied properties of quartz

many times the operation is repeated, with no sign whatever of permanent set.

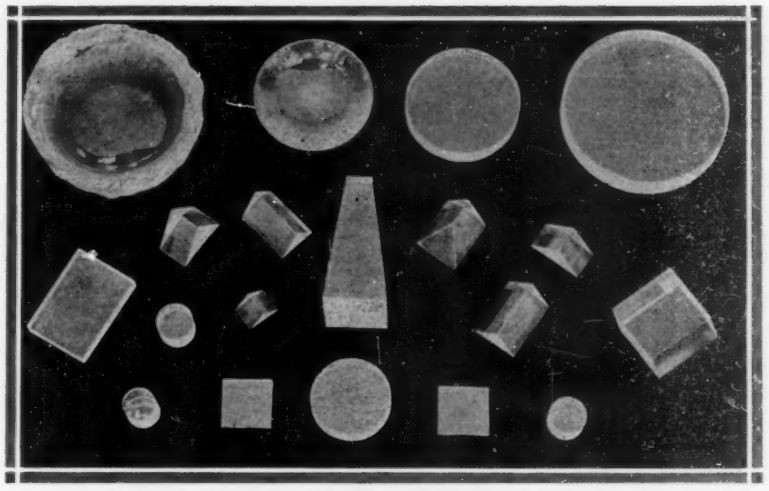
Obviously the manufacture of such a very refractory material is going to present difficulties. It has always been possible to bring quartz to the fusion point in the oxygen flame, and to shape it more or less after the fashion of glass-blowing. But its consistency at the temperatures thus attainable is such that it cannot be made into smooth shapes of any size. The technique consists in piecing together small sections of crystal, or in adding silica powder from time to time, and the separate increments are always defined in the final product, so that a large tube, for instance, has the rough annular appearance of an intestine. And in addition to this, it is clearly a very slow and expensive process thus to make shapes of any great size. But hand-made quartz is now obsolescent.

When it is desired to obtain fused quartz of the quality illustrated in our photographs, it is necessary to start with the very highest grade of raw material. Of the various forms in which silica occurs, there is none better than water-clear crystals. It is far more difficult to make high-grade fused quartz from sand, even though this be 99 per cent pure. The rock crystal used at Lynn is imported from Brazil and contains probably less than two-tenths of 1 per cent of foreign matter. But the surface is often encrusted with iron oxide and other foreign materials, and the crystals usually contain bubbles. The one defect is remedied by washing in acid, the other by breaking up the crystals into small pieces.

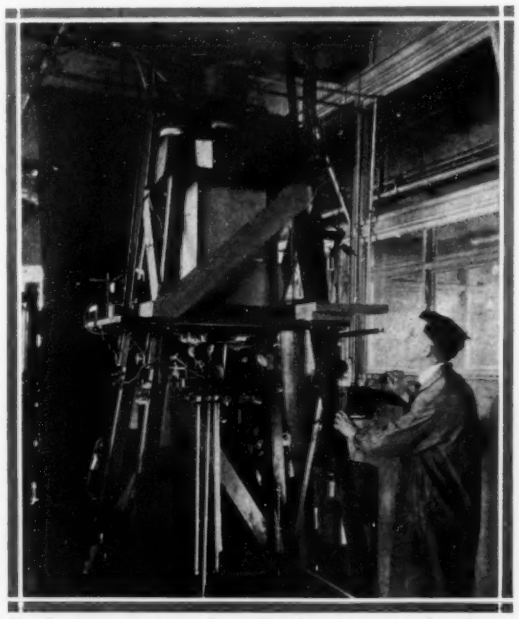
The next step is fusion, in an electric furnace. For fusing quartz a graphite crucible is necessary, this being about the only substance with a higher melting point that the quartz itself. But a chemist might be forgiven for refusing to try it, since it is so entirely obvious that the silica and the carbon will react to form carborundum (silicon carbide, SiC), with release of oxygen. Messrs. Berry and Devers, of the General Electric Laboratory at Lynn, however, went through with it, and discovered that the carborundum first formed was laid down over the surface of the graphite crucible, and that as soon as this was completely crusted over the action between the silica and the carbon automatically ceased.

To prevent oxidation of the crucible (the material of which vaporizes without melting at the temperature attained), and to minimize the formation of bubbles in the soft silica, a high vacuum is necessary in the furnace. But since no vacuum is perfect, and since in any event some oxygen will be released in the formation of the protecting coat of carborundum, bubbles will occur; so the vacuum must be followed by high pressure to eliminate these. For the formation of rods and tubes of quartz, the soft material is extruded through holes of proper diameter in the bottom of the furnace, with or without a core as the case may be; and for these shapes the necessary pressure to eliminate serious trouble with bubbles is obtained from the graphite piston that forces the plastic mass out. A means is provided, outside the furnace, for cutting the sticks off at the proper length. The silica remains in the furnace for about 18 minutes, being heated to some 4000 degrees Fahrenheit; it then emerges with about the consistency of soft molasses candy, and very rapidly hardens to a degree that prevents distortion. It is practically free from bubbles but because of limiting dimensions it may be necessary to rework some of it. This will ordinarily be done by the usual bench methods in the oxygen flame; but for small specialized shapes grinding is available. Of course anything like casting or molding is out of the question.

For lenses and other purposes it is often necessary to produce the quartz in a large block. For this it is fused in a furnace of different type, with high-pressure gas inlet as well as vacuum. As soon as fusion is complete the vacuum is cut off and the pressure in the tank is brought up to whatever figure may be necessary. The bubbles which are present in the mass have been formed in vacuum, are of low pressure themselves, and collapse under sufficient squeezing; but even so, the pressures used are such as to strain ingenuity in the design of a furnace head that will come off for charging, yet will be gas tight in use. An interesting fact in this connection is that in the head as ultimately constructed, the addition of a single rivet with its attendant hole would have resulted in a net weakening of the cover unit.

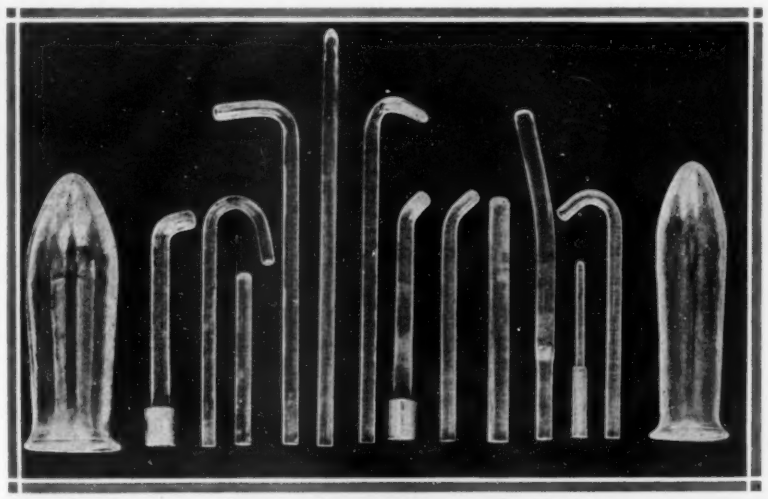


Lenses, prisms, cubes, etc., of clear fused quartz; for the most part these pieces were shaped by grinding



Producing quartz rods and tubes by extrusion from electric furnace, under high pressure

If the clear fused quartz could be produced in sufficient quantity, it would probably become the commonest of all materials in use. As it is, the factory process will partake so largely of the characteristics of laboratory work that great quantity production will apparently not be feasible. Also, the cost will apparently remain the determining factor; and the makers of the new material will discourage its use wherever the advantages over glass or metal are not sufficient to justify the added expense. The place where this condition is most clearly met is in the astronomical observatory. The grinding of large lenses and mirrors is such a tedious and expensive process largely because of the heat developed, which demands very slow work and frequent stops to avoid permanent deformation through expansion, and to permit accurate estimate of the figure that is being attained. In grinding quartz, it will be possible to work faster and without interruption. Further, the very small expansion and contraction in use will diminish the distortion of image which is now the limiting factor in the size of lenses and mirrors. The much-abused word "revolutionize" is employed by one eminent astronomer to characterize the reaction upon his science which will come from the general introduction of quartz in telescopes and prisms. Spectroscopy will benefit as much as direct observation, because of the smaller loss of light through absorption within the prism, as well as the greater range of spectroscopic observation which will be enjoyed with prisms that handle ultraviolet as well as visible wave lengths. Particularly there will be important new work with larger prisms than the astronomer has ever dared use in glass.



Clear fused quartz applicators of various types employed with quartz mercury-vapor lamps

Perhaps the next most important group of applications is that which arises out of the transparency of quartz to the ultraviolet, coupled with the fact that these rays are the most powerful germicide known. The ability to focus them lent us by the quartz lens will have wide use in hygiene and medicine, and the ability to have ultraviolet light indoors, through quartz windows, will be of the utmost importance in hospitals and other places. The trick of passing light around inside a curved rod will be of value for direct internal application of ultraviolet light. These are but a few suggestions for the very extensive applications which will be found for the new "glass" in all branches of health engineering; for it is the only material known which is obtainable in quantity and which is transparent to ultraviolet light.

An industrial use of importance will lie in the motion-picture industry. The glass lenses used in location work usually crack on first use, under the intense heat of the focussed light. Costing something like $25, they are used in this cracked condition until they fall apart. On the other end of the line, in the projection room, the glass lenses, with a regular electric bonfire at very close quarters, crack at the rate of one lens per day per machine, and those that do not crack become badly pitted through vaporization of their more volatile constituents. In both departments of movie work the quartz lens is the simple solution.

The same specter of permanent distortion following frequent expansion and contraction which plagues the astronomer, arises again in the use of glass thermometers. A tube which is raised from zero (Centigrade) to 550 degrees, and then brought back to zero, will have been so deformed by the process that on second contact with the freezing point, it will register anywhere from 4 to 16 below. No glass thermometer that is subject to rapid or extreme fluctuations of temperature can remain permanently accurate. Indeed, the process is a continuing one, so such a tube cannot even remain consistently inaccurate. Bad enough under any conditions, this reaches the climax of objectionability with the clinical instrument. The quartz thermometer, on the other hand, will have a permanent figure and a permanent accuracy.

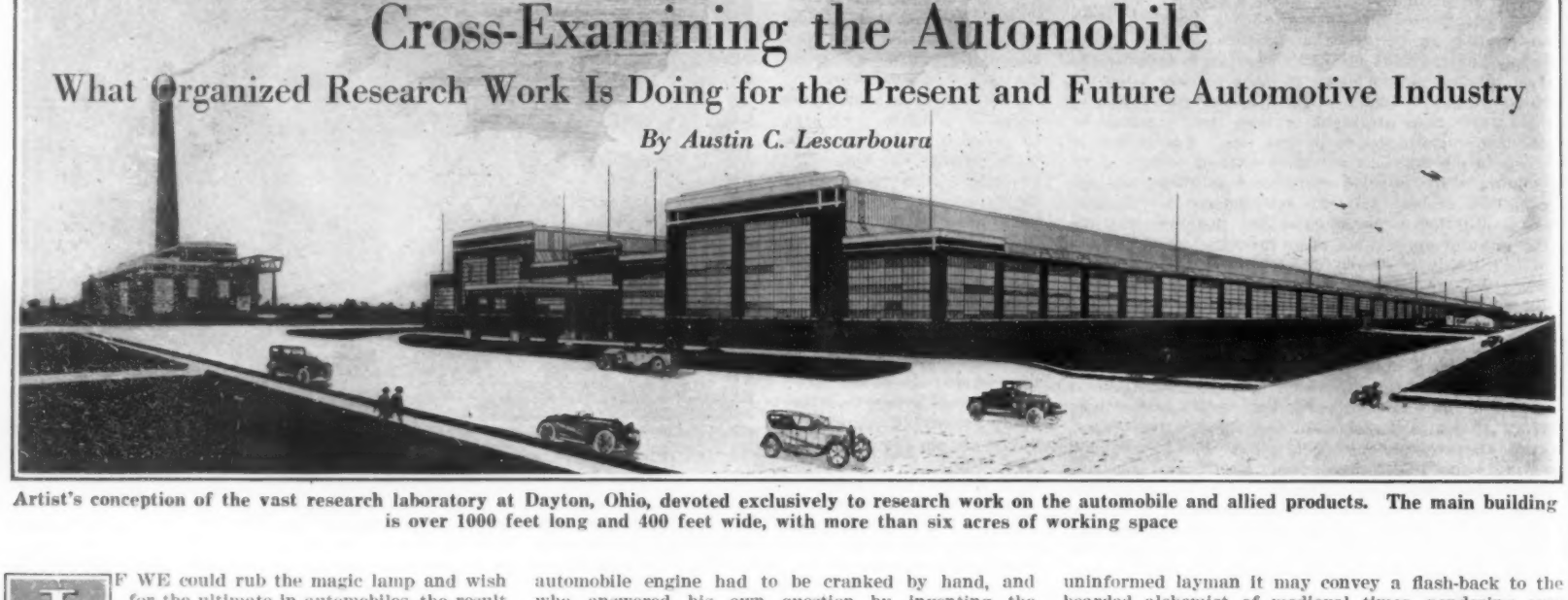
Transparency is but one of the properties which we have listed for quartz; there are lots of places where its low expansion or other characteristics will enable it to replace metals, the transparency being purely incidental. For instance, there is the matter of the tuning fork. If this instrument is to maintain its true pitch, it must retain its physical figure within very narrow limits. A fork of steel will vary in length and hence in pitch at different temperatures. Worse yet,

(*Continued on page 59*)

Cross-Examining the Automobile

What Organized Research Work Is Doing for the Present and Future Automotive Industry

By Austin C. Lescarboura



Artist's conception of the vast research laboratory at Dayton, Ohio, devoted exclusively to research work on the automobile and allied products. The main building is over 1000 feet long and 400 feet wide, with more than six acres of working space

IF WE could rub the magic lamp and wish for the ultimate in automobiles, the result of our wish might be something like this: A five-passenger closed car, weighing less than 1000 pounds; a new form of power plant, embodying a lighter but more powerful engine, with lower fuel consumption; with lubrication that would be practically automatic and that would include frictionless bearings in inaccessible places; vibrationless operation, due to perfection in balance of parts; freedom from noise and with no possibility of "knock," through the use of treated fuels introduced into the combustion chamber; longer life than any present-day car, with a minimum of repairs and adjustments, and a maximum of reliable and pleasing service on the road; and a finish that would stay new with little if any care.

That is what all of us eventually seek in the way of an automobile. We do not realize it until we see these specifications in cold print. Quite human-like, we have become more or less satisfied with the automobile of today because, in comparison with the vehicle of our forebears, it is a marvelous piece of mechanism. Then, too, there is nothing better in sight. Little wonder, therefore, that the automobile has come to be accepted as a highly perfected product. Most of us do not expect much in the way of improvements save for such refinements and secondary innovations as four-wheel brakes, balloon tires, satin finish, courtesy lights, centralized controls on the steering wheel, and so on. As for the basic features or fundamentals, we have come to consider them established and here to stay.

Back to Fundamentals

Meanwhile a little surprise party is being arranged for our benefit. One of the outstanding research engineers of this age has been cross-examining the automobile and ascertaining some rather startling facts. Charles F. Kettering, assisted by twenty-five engineers in charge of the major sections of a vast research laboratory in which hundreds of men are engaged in actual research and development work, has picked apart the automobile down to its very essentials. This cross-examination has revealed the rather startling fact that little in the present-day automobile design rests on a severely logical basis. In general, the automobile is simply a refinement of the crude ideas of the pioneers in horseless locomotion. We have continued to do certain things in the same old ways merely because no one ever questioned those ways. And, after all, that is a dyed-in-the-wool characteristic of the average mortal.

Now comes this vast organization, with everlasting questions which demand an answer. It was one of these men who asked why the automobile engine had to be cranked by hand, and who answered his own question by inventing the electric self-starter. The same man asked why the farmer and the rural home could not enjoy the comfort and convenience of electric lights, and he answered that question by developing the compact gasoline-driven generator for home-made electric lighting. And this same Kettering is now engaged in asking more questions than ever, and answering them one by one with the aid of a corps of skilled assistants and with the facilities of the largest research laboratory in the world devoted to automotive and associated problems.

Six miles in a general southerly direction from Dayton, Ohio, will be found the vast and impressive workshop of the General Motors Research Corporation laboratory—a vast building over 1000 feet long and 400 feet wide, with the equivalent of more than six acres of working space under a single roof. Here are exceptional facilities for systematic experimentation by a body of trained technicians—facilities far beyond those available to any individual manufacturing organization. The entire plant is devoted solely to research work; if there is any manufacturing connected with this establishment, it is solely the manufacturing of ideas.

What Is Research?

Under the direction of Mr. Kettering, there are, in all, some four hundred engineers and workmen engaged in research activities. The work is divided into various categories, such as mechanical engineering, fuel engineering, chemical and metallurgical control, chemical and metallurgical research, electrical engineering, dynamics engineering, technical data, experimental production, semi-works engineering, and special problems. Each category is assigned to one section under a competent chief, and all efforts are co-ordinated and skillfully blended in order to make for the best composite result.

To the average man, research means little. To the uninformed layman it may convey a flash-back to the bearded alchemist of medieval times, pondering over bulky books and studying the evolutions inside his chemical retort. Again, it may bring to mind the puzzling products of some highly specialized forms of research, such as how much salt there is in the Indian Ocean, a one-thousand-page volume on plow-share designs and how much soil they displace, a report upon the quantitative determination of carotin by means of the spectrophotometer and the colorimeter, and other equally uninteresting documents which, to the average man, seem such a waste of valuable time and effort. Even in the highest business circles the real meaning of modern research is not fully comprehended, with the result that many a product is sadly lacking in proper development and many a manufacturer finds his markets slipping away from his former firm grasp.

Research is a very necessary factor in every successful business, no matter how large or how small it may be. Research points the way to improved products. Research cuts down manufacturing costs by simplifying and perfecting the product, and by working out better production methods. Research steadily improves the existing product and develops new products, so that the manufacturer may keep abreast of the trade. Research saves money and makes money for the manufacturer. Research is an investment which returns big dividends; research, properly conducted, never costs money when the final balance is struck.

Now at this research laboratory the machines, the instruments, the laboratory apparatus—all are but yardsticks which measure how accurately the brain factory has produced a useful result. Thoughts are things. Fundamental truths are things. These intangible, invisible forces may not be perceived by the five senses, but they are the things which the research laboratory deals with.

The research man must get a firm grasp on an abstract idea and translate it into words or sketch it on a piece of paper. It has then assumed tangible shape that may be grasped by our five senses. Next may be brought into play the multiple brain-power of other workers. At this point material things like wood, copper, iron, are fabricated to harness this force to some useful end.

One of the many testing rooms in the research laboratory, where motors are operated on the test blocks

Let us carry our simile back to the man who first conceived a pair of scissors. After he had finally worked the idea into shape he took iron and made himself a pair of scissors. They cut. We say we can see them cut. But we can no more see the force which makes them cut than we could have seen the crude idea of the scissors in the brain of the man. What the inventor of the scissors did was to utilize leverage to produce shearing. It was the force and its application, and not

the tangible scissors, which the creator worked out in his mental blacksmith's shop. Truly, that is the kind of process going on every day at the great research laboratory in question.

Pure research concerns itself with establishing and proving principles. Experimental research or engineering, the second step, is ascertaining the utility of principles. Development engineering is perfecting the utility. Production engineering has to evolve methods of manufacture. The work of the Dayton laboratory embraces all these steps. As it is primarily a commercial research institution devoted exclusively to obtaining information for the use of manufacturing and operating units comprising the huge affiliated organization, every effort is directed toward some useful end, toward improving existing products, and toward creating better products at lower costs.

The Automobile in the Test Tube

Everything works down to the elementary fundamentals. No matter how complicated the problem, the solution will be simple when found, we are told. So when the automobile was tackled by the research men in this vast laboratory, it was split up into its various components and each component was assigned to one department for painstaking study, criticism, experimentation, and ultimate development, if not so-called perfection. Perfection! That word is tabooed by the true research man. Perfection is the unattainable goal.

Strange as it may seem, the automobile, which we have come to look upon as such a splendid piece of work, presents plenty of room for constant improvement when analyzed by these hard-headed technicians. Taking up one feature after another, they soon discovered that virtually nothing in the present motor car is firmly rooted. Nothing is there because it is the best means to the desired end. And, looking at the matter purely from the fundamental physics and chemistry involved, these research men continually see the possibilities for vast improvement. Hence their unrelenting work now under way, and the resultant better and more useful utilities available to society.

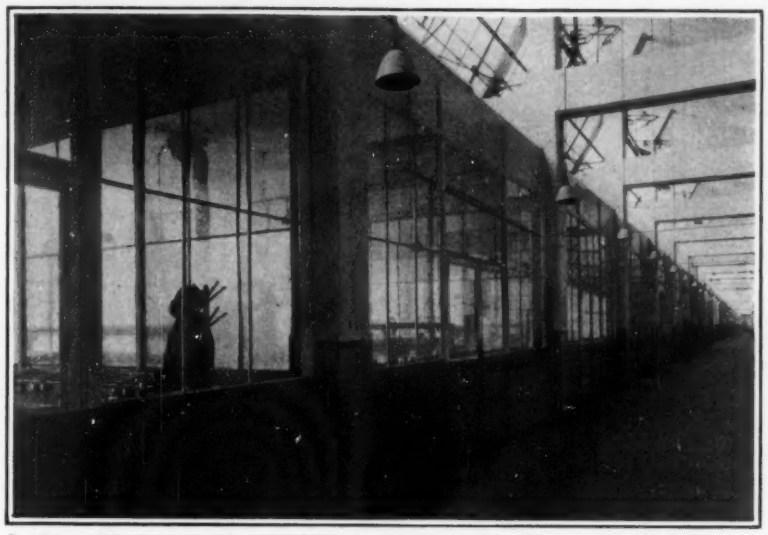
It was a Saturday morning not so long ago when the writer visited the vast laboratory and was shown through this impressive establishment by the coordinating engineer, whose function is clearly indicated by his title. Later, Mr. Kettering joined our party.

First, we visited the fuel engineering section, where some of the immediate results of the scientific work are to be found. Ever since its inauguration the laboratory has been engaged in an exhaustive study of combustion. The problem has been to find ways of increasing efficiency by getting more of the power out of the gasoline and into the rear wheels.

Automobiles now have low-compression engines utilizing under best conditions but 10 to 15 per cent of the energy in the gasoline, according to Mr. Kettering. When the gasoline and air are taken into the cylinder and compressed just before the explosion, the pressure inside the cylinder is relatively low—about 80 pounds per square inch. If this pressure could be doubled it would make possible a corresponding gain in power with no increase in consumption of gas. But when even the present low compression engine is pulling under full load, and especially at low speeds, as for instance uphill in high gear, there is the tendency to knock, which decreases power. And if present-day commercial gasoline is used in high-compression engines this knock not only occurs all the time, but also becomes dangerously violent. Because of this knock, high-compression engines are not practical for automobiles using ordinary commercial gasoline.

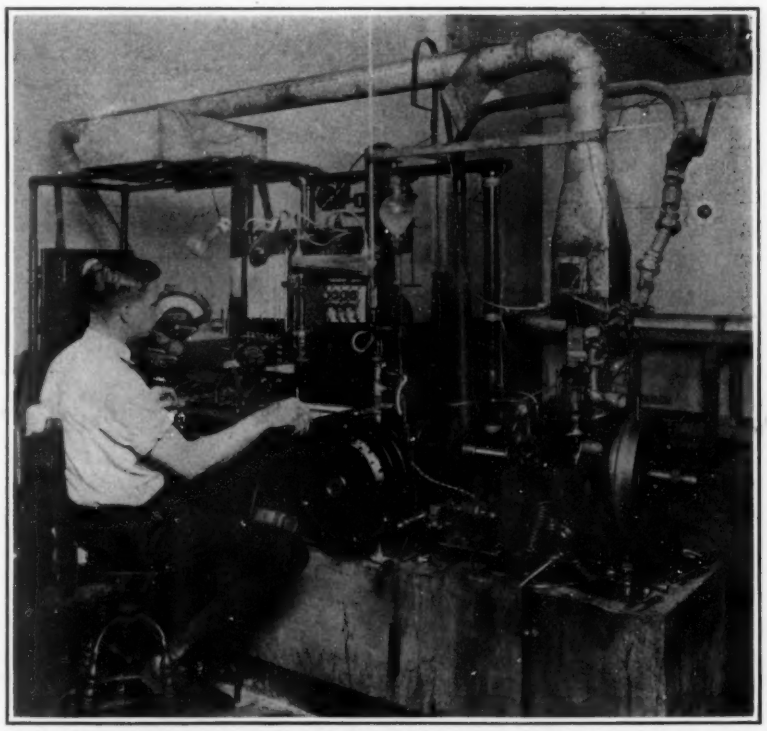
The research engineers went to work to learn what produced the knock. They found two distinct explosions in the engine cylinder as the result of an ignited gas charge. The first explosion is so sudden and violent that it simulates a hammer blow on the piston. It is this explosion, known as the detonation, which produces the knock. The second explosion, seventy times slower than the first, is the explosion which we harness and convert into power. There being no feasible way to harness the first explosion, the obvious expedient has been to dispose of it or at least remove its sting.

As the result of these extensive studies, the research engineers have developed chemical compounds which, mixed with the gasoline, eliminate the preliminary explosion with its knock and permit the use of commercial grades of gasoline in high-compression engines. This means that small, high-compression engines can be built which will develop power equal to the large, heavy, less efficient engines now in use. It will mean in turn that the chassis can be lighter, and that, translated into popular terms, means lower-priced cars.



Looking down one of the corridors in the research laboratory building, showing how each section has its own walled-off space

The writer was shown the cause of the knock and how it could be eliminated by the ethyl-gas fluid or "dope." A small gasoline-electric high-compression unit for home lighting was operated on the usual gasoline, sucked out of a test tube. The engine developed a bad knock. The ammeter showed a current of 16 amperes. Then, when the first test tube was replaced by another containing "doped" gasoline, the knock soon disappeared as the new fuel reached the combustion chamber, and the ampere reading rose to 26, showing how great is the power-loss in the knocking engine.



Research engineer working out the characteristics of a gasoline engine on the test block

Many correlated problems had to be solved in connection with the ethyl-gas fluid. Aside from that of reducing the cost of the rare and expensive ingredients, there was the problem of getting the "dope" into the hands of the motorist. The logical solution of this problem was to place the supply in the hands of the gasoline distributor, who in turn could distribute the "dope" through the usual gas stations. But for several years the high-compression engine that needs the dope will be on the road side by side with the low-compression motor that may not need it, but finds it of great advantage to run smoothly and be free of carbon troubles by its use. To avoid the necessity of duplicate underground tanks at the filling stations has called for the development of a dispensing device, which has taken the form of a small auxiliary pump to be mounted on the standard gas pump in such a manner that it delivers the "ethyl" directly into the gas hose. For each gallon of gas the auxiliary pump is cranked to discharge about a teaspoonful of "ethyl" into a visible tank, and as the gasoline is delivered to the motorist the red ethyl-gas fluid is discharged into the hose. "Doped" gas will soon be available to motorists.

That pesky thing known as "carbon" has also gone into the researcher's test tube. Much to his surprise, the deposit which causes our engine to become choked up, lose its power and knock on hills, proved to be several other things besides carbon. The chemistry of the so-called "carbon" disclosed that the chief offender was a non-volatile binder which held the mass of road dirt, tarry substance, and true carbon in the cylinder, safe from the hot flame of combustion. So the researcher went to work trying to break down the binder. In due course he developed a solvent for the binder. And now we are to have a carbon remover that really works. One teaspoonful in each cylinder will break down the binder, and the hot flame of combustion does the rest by converting the true carbon and the tarry substance into gases which are carried out through the exhaust.

Running Cars to Destruction

One of the several score departments of this laboratory is just a big garage, conducting road tests of automobiles. In this section the drivers and mechanicians are grouped into crews working day and night on regular shifts. Cars produced by all manufacturers are continually on test to obtain facts which are made the basis for standard comparisons.

A typical road circuit is 86 miles of sand, mud, dirt, paved boulevard, city streets, good country roads, poor roads, up hill, down hill, level road. It combines everything the average motor car user will encounter and makes an ideal laboratory test.

The automobiles are given the best attention but are driven hard and relentlessly until they break down. They carry full load at all times, sand bags being used in place of flesh-and-blood passengers when necessary. If a car requires repairs the work is done on the road, or the car is hauled into the shop and put back into shape. Each car in three months is run 25,000 miles, and is then taken down for complete examination and measurements for wear.

It is interesting to see how the cars fare under such gruelling conditions. The writer was shown an enormous chart, carefully ruled off into sections and labeled for the major features of the automobile, and with each section sub-divided so as to get down to such little details as shackles and hub bearings and drag links. Every time a car displays trouble of any kind, a black dot is placed on that car's record under the appropriate heading. Purposely, the cars are given cryptic numbers, so that at no time does the chart disclose what particular make of car is conspicuous by its collection of black dots.

The writer studied this chart for some length of time, for here was to be found a concise story of the strong and weak points of the regular run of cars. Despite the fact that most manufacturers lay great stress on engine design in their yearly improvements, the engine, according to this chart, has long since reached the point where it might well be left alone, and other

(Continued on page 59)

A bird's-eye view of Meteor Crater, Arizona. For many years the consensus of scientific opinion rejected the suggestion that this was an "impact crater." Mr. Barringer, its owner, has now proved incontestably that it is such and seeks to extend the impact hypothesis to the moon's many craters

Volcanoes—Or Cosmic Shell-Holes?

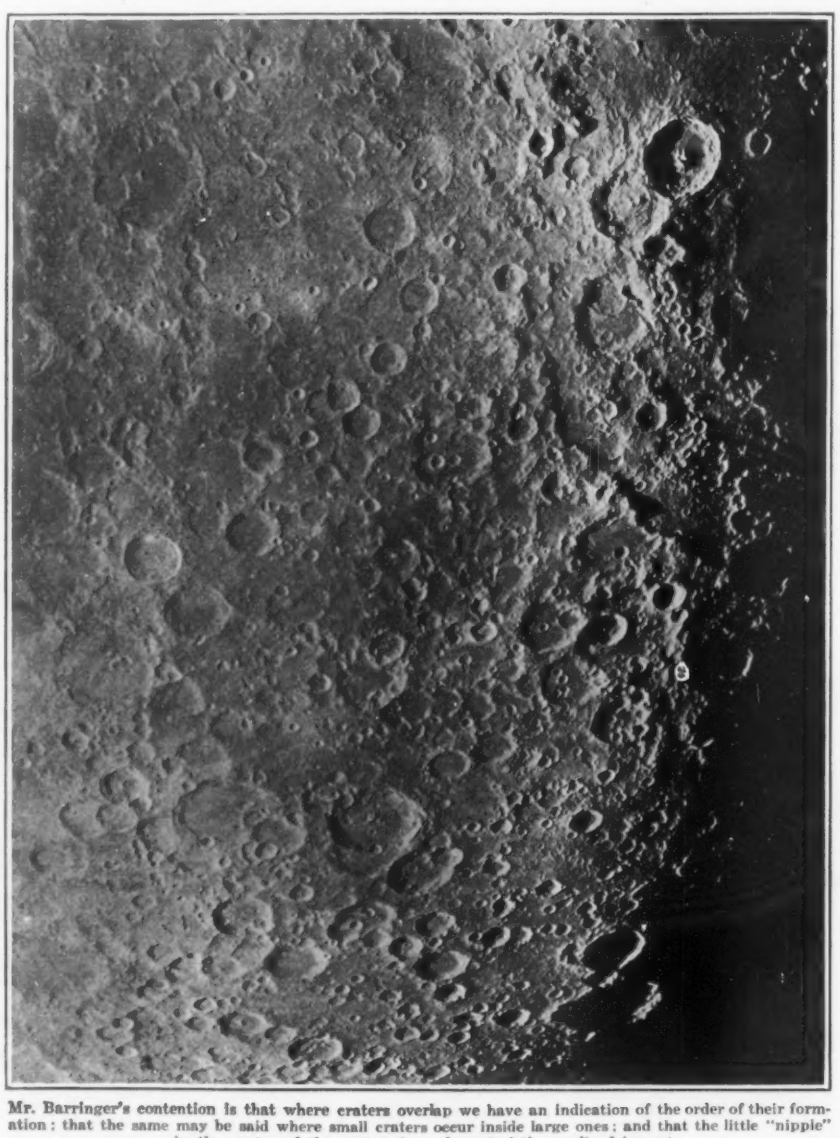
A Discussion of the Origin of the Craters on the Moon, and of Other Features of Her Surface

By Daniel Moreau Barringer

OWING to the fact of my having been privileged to be the discoverer of the origin of the Meteor Crater in Arizona and to be able to prove that it was produced by the impact of a large mass of meteoric iron, very probably, as I have stated, in the form of a compact cluster of iron meteorites, my interest in the lunar craters has been greatly increased. I have not only observed the moon in its different phases through both large and small telescopes (24 inches and 6 inches) but I have critically examined with a reading glass several of the best photographs recently taken by the 100-inch reflector at Mount Wilson. The photographs in W. H. Pickering's book "The Moon" (1903) have also been carefully examined.

In this paper I propose to discuss briefly the possible origin of these remarkable craters, some thirty thousand of which can be counted on the face of the moon which is presented to us. As is now assumed there are only two possible origins. These craters are either volcanic craters or they are due to the impacts of extra-lunar masses of matter. I shall first discuss the volcanic theory of origin, which is the one commonly adopted by astronomers and by many geologists. I am of the opinion that very few of the latter have given much thought to the lunar craters, accepting without question the opinion of the astronomers as to their volcanic nature.

It goes without saying, of course, that physical and chemical laws are the same on the moon as on the earth. The weight of scientific opinion, both among astronomers and physicists, is that the moon has never had an atmosphere. Jean says from the kinetic theory of gases, that owing to temperature conditions and to its small mass the moon probably lost very quickly any gases it may have had about it. Therefore, it would seem that the moon has never had what we know as meteoric water, which is one of the greater factors, if not the chief factor, either when converted into steam or in rendering fusion of rocks more easy, in producing volcanic phenomena on this earth. No water, no volcanism. It is not conceivable to me that the so-called water of crystallization, if it exists in the rocks composing the superficial crust of the moon, as in this earth, would be sufficient to produce volcanic phenomena even on a limited scale. Again, a study of the volcanic craters on our very much larger earth not only shows them to be *far less numerous* than the lunar craters but that no two of them are exactly alike. There are several types of terrestrial craters, but I know of none which are really like the typical lunar craters in their physical aspects. A critical comparison of the chief characteristics of the craters of the earth and those of the moon will quickly convince anyone of this fact. The great lava flows, so typical of the craters of the earth, are in every case wanting in the lunar craters. There is not a single conical mountain peak on the moon which is similar to Fuji, Aetna, Vesuvius or Orizaba and other volcanoes of this type, made by the effusion of lava from a central vent and the building up of the mountain mass higher and higher as it flows down its sides. I know of no crater on the earth which has in its center a conical shaped hill similar to those which are observed in a great number of the lunar craters. These central and conical shaped hills or protuberances in the lunar craters will be discussed later, for they are probably very significant and in themselves furnish proof of the impact theory of origin. It is inconceivable to me that if there was the enormous volcanic activity which is generally thought to have taken place on the moon before it became "frozen," so to speak, by the cold of space, there should not have been at least some typical, very large and long lava flows from these great vents. Yet, as stated, not one is to be found. The so-called "mountains" surrounding the circular "seas," which will be discussed hereafter, may possibly suggest lava flows to some observers but they are not at all suggestive of them to me. They are much more suggestive of gigantic splashing effects radiating from a common point of disturbance—as I think, the point of impact of some extralunar mass or masses. Again there is no evidence of fissures, great or small, from which lava has flowed over the surrounding lunar surface. The so-called rills or cracks in the surface of the moon are probably, as has been suggested, effects of rapid cooling and shrinking. It is not necessary in order to explain them to call in the assistance of volcanic agencies, as will be seen from what follows. Physical laws being the same on the moon as on the earth, the remarkable absence on the moon of the typical volcanic phenomena of the earth is certainly very significant. In brief, the more one endeavors to institute a critical comparison between the alleged volcanic phenomena of the moon and the known volcanic phenomena of the earth the more one realizes that the two are very dissimilar.



Mr. Barringer's contention is that where craters overlap we have an indication of the order of their formation; that the same may be said where small craters occur inside large ones; and that the little "nipple" in the center of the craters is a characteristic result of impact

The great region of craters on the moon's surface south of Theophilus

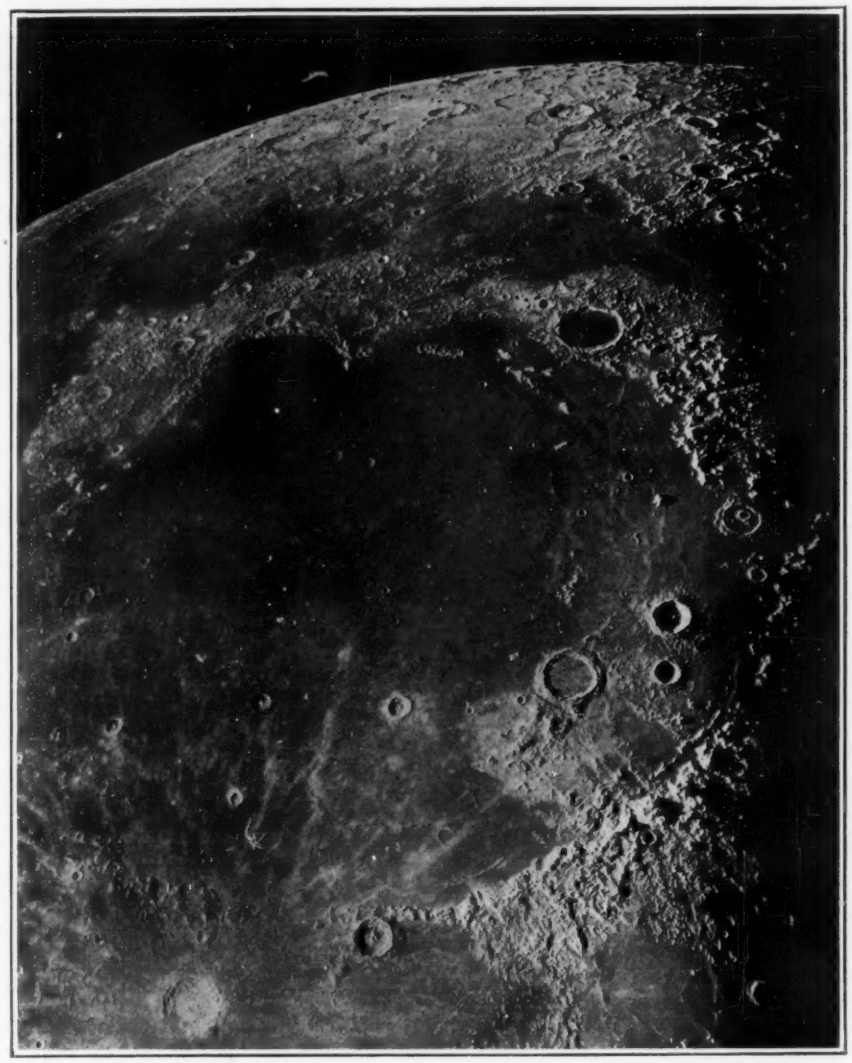
The other theory of origin is, of course, the impact theory. As far as I can ascertain Richard A. Proctor was the first prominent man of science (1873) to advance this theory ("The Moon," p. 346), but I have seen an old paper also written about fifty years ago by Dr. W. S. Bigelow, which has been sent to me by Professor Elihu Thomson, in which the author argues against the volcanic theory of origin. Before going further I wish to acknowledge my indebtedness to Professor Thomson, who, because of his far greater knowledge of physics and of astron-

omy, has made certain things clear to me in our discussions of the subject which previously were not clear. I also wish to acknowledge my indebtedness to Professor William F. Magie, whose criticisms have been most helpful.

The thought which I have given to the problem during a number of years past has convinced me that the evidence, once it is fully appreciated, is all in favor of the impact theory of origin of the lunar craters as opposed to the volcanic theory of origin. As I shall point out later, and as I have previously pointed out (Further Notes on Meteor Crater, Arizona—The Academy of Natural Sciences of Philadelphia, September, 1914), there exists a remarkable similarity between the Meteor Crater of Arizona and the lunar craters, whether small or large. It is interesting in this connection to note that the Arizona crater would be visible with difficulty, if at all, with a 24-inch glass if it were on the moon. On the scale of one of the Mount Wilson photographs above referred to, on which scale the lunar crater Copernicus (55 miles in diameter) is shown as having a diameter of about one-half inch, the Arizona crater, which is over three-quarters of a mile in diameter, would be only about 1/145 of an inch in diameter, possibly too small to show on that photograph. The wonder, therefore, is, as I have pointed out in an earlier paper, that the Arizona crater is as small as it is and not that it is as large as it is.

I propose first to discuss the typical lunar craters and then the so-called "seas" or plains before entering upon a more general discussion of the subject.

1. Many thousands of typical craters and the remnants of older craters are visible on the face of the moon which is presented to us, and, of course, there is every reason to believe that there are just as many on the other face of the moon upon which the human eye has never looked. Moreover, we note that there is a very great similarity in nearly all of them. This is profoundly significant. It is a general effect which is difficult of explanation on any other theory of origin than the impact theory. It cannot be mere coincidence that they are so remarkably like the Arizona crater which we know to be an impact crater. So far as we can judge they bear exactly the same evidences of impact, so much so, in fact, that a photograph taken from an airplane of the Arizona crater would be almost exactly like the photographs of the vastly larger crater Copernicus, as an example. An interesting feature, common to most of them, is the central projection, protuberance or hill, a veritable mountain in some of the larger craters, rising out of the floor of the crater. I am informed that this floor is usually far below the original surrounding surface. To appreciate the cause of these nipple-like hills being in or very near the exact center of the craters one should read Professor Worthington's book "A Study of Splashes." As I pointed out in one of my papers on the Arizona crater I was hard put to it at first to explain a somewhat similar protuberance in that crater until I noticed carefully an unusually large raindrop falling into a small and perfectly still pool of water. There was first a surging outward of the impacted water, then a surging backward toward the center until a conical "hill" of water was formed in the center of the disturbance, which, of course, quickly subsided into the water from which it had been forced to rise. The same effect can be obtained by dropping a stone or bullet into very soft or liquid mud. In the case of pulverized rock or larger rock fragments the central conical hill would remain, as it undoubtedly has done in the case of what is known as "silica hill" in the floor of the Meteor Crater of Arizona, and, as I believe, in the floor of all the lunar craters where this feature is observable. Worthington points out that solids will flow and behave in much the same way as liquids if sufficiently great pressure is suddenly applied. In some of the lunar craters this effect has been masked or is absent, because the impacting mass did not strike with sufficient force or possibly with too great force, as will be discussed hereafter; because they have been filled up by cosmic dust or material thrown out of neighboring younger craters; or because the impact was on or near the edge of a great plain or "sea." I shall attempt to explain this effect hereafter. Again the small holes or, as they have been called, "vents" which are observable in the very crest of many of these peculiar central conical hills are not vents at all, in my opinion, but simply represent the effect of the settling through untold ages of the rock fragments. Contraction on cooling may have assisted in producing this effect. It must always be borne in mind that there has never been any wind or rain to interfere with the steady downward pull of the moon's gravity. In the case of a great pile of rock fragments of which, as I think, the central hills are composed, it is easy to imagine such an effect of gravitative force as these depressions or cavities which we observe in the tops of many of them. In a number of cases it would seem that the central hill had fallen down or apart after being formed, an effect which is also apparently due to gravitative force. The equilibrium of the rock fragments forming such a conical hill could easily be disturbed by the jarring which would result from a neighboring impact as well as by other causes.



On the scale of this photograph the Arizona meteor crater would be 1/145 inch in diameter, and would perhaps be invisible from the earth with a 24-inch lens

More general view of a considerable portion of the moon's surface, showing several of the larger craters, and one of the huge "seas"

2. A further study of the moon's surface leads one to conclude that the so-called "seas," all of which are roughly circular, can be regarded as evidence of enormous additions of matter to the moon's mass. They may have been made when the moon's surface was in a more or less plastic condition, it having been rendered more liquid; *i. e.*, less viscous, by fusion. The molten material, in some cases composed of both melted target and melted projectile, would violently spread outwardly, as I think, in a more or less circular manner, that is radiantly from the point of impact. It may be even more probable that great masses of extralunar material broke through a comparatively thin "frozen" crust into liquid material beneath, or possibly by relief of pressure permitted the solid but already highly heated rock beneath to become liquid, causing violent outbursts of the liquid lava-like material which would flow outwardly and more or less radially from the point of impact and over the hard surrounding surface of the moon, obliterating or filling older craters in its path. The crust of the moon when cold and thick does not seem to have been fused. There can be no doubt that a great part of the energy was not converted into heat but was exerted in producing the effects of crushing, pulverizing and excavating the hard rock composing the crust, with the result that effects were produced similar to those observable at the Meteor Crater of Arizona. A critical study of the photographs would seem to indicate that in general this is the correct theory of the origin of the seas and that not improbably they represent the effects of comparatively late collisions. The fact that there are relatively few craters representing later impacts on their now solidified surfaces would seem to indicate that this is true. These features of the moon's surface deserve closer study than I have been able to give to them, but in my opinion they afford no evidences of what we recognize as the results of volcanic activity. On the larger photographs one can see certain peculiar low ridges on the surface of the "seas" which are strongly suggestive of buckling or wrinkling of the lava-like material upon cooling. Whatever the origin of the various features of the lunar surface, I cannot escape the conclusion that they have had a common origin and that the evidence, regarded as confederate and linked together, is overwhelmingly in favor of their being due to impact rather than to volcanism.

3. All of this, I am informed, is not in contravention of the theory held by some that many of the orbs composing the solar system were largely once in the form of gas which upon contracting became liquid before becoming solid. During their liquid state the planets and moons would, of course, by the action of gravitative force, assume a spherical form. Later on they probably received a vast number of additions to their mass. Also the impact-crater hypothesis is not in any way in contravention of but is rather in support of the theory that our present solar system represents the bursting up or tearing apart of a pre-existing system, or possibly of a dead sun without planets revolving about it, and that the nebula out of which our system has been reconstructed was composed, to a certain and probably to a very large extent, of masses of solid matter, the fragments of the disrupted body or bodies. I have been told that the orbs of our system need never have been really gaseous or liquid to have assumed practical sphericity if large enough. This solid matter floating in space would gradually gravitate together and form compact clusters, as I assume, and these in turn would gravitate toward other larger clusters or masses until a planet or its moons became the result. It is not difficult to believe that the heat caused by the inconceivable force of some of these impacts, when the conditions were favorable, would produce fusion and that liquidity or plasticity would result. Also that finally the outer surface would yield to the cold of space and cool off to become first plastic and then solid. On this theory we are, of course, observing the effects of the more recent bombardments.

It is not difficult to visualize these conditions or steps in the building up of the moon and possibly every other orb of our system, the sun included. When one has once visualized them it is not difficult for a student of the moon's surface (it can be studied by the ordinary student better from photographs than through a telescope, although the latter reveals some important features which are not revealed by the photographs) to realize that Mare Imbrium, Mare Humorum and

(*Continued on page 62*)

Our Point of View

Our Battleship Fleet Is Not Junk

THE American public has recently been bombarded through the press with a mass of misinformation about the United States Navy and particularly about its battleships, which must have left the public sorely perplexed. Also, there has been widely published a report by Rear Admiral Coontz, upon the defects of the United States fleet which were disclosed in the winter manoeuvres. The first-mentioned statements were made by a layman who must have been vastly surprised to find himself spoken of as an "expert"; the latter criticisms are of course to be taken in all seriousness.

The articles which place the United States in the third position, in a ratio, Great Britain five, Japan three, United States one, are so full of gross exaggerations as to refute themselves in the minds of all people who have any reasonable knowledge of naval conditions. They represent the latest outburst of an exaggerated and misleading propaganda, aimed to discredit the Washington Treaty. The phraseology and manner of stating the so-called facts in these articles, suggest, though of course they do not prove, that the source of information is to be found in that happily very small clique of naval officers, who, from the first, have bitterly opposed the naval treaty, and which, though debarred from writing over its own signature, has been sending out dispatches, dated Washington, all aiming to show that the United States Navy got a "raw deal" at the Washington Conference. The vast majority of our naval officers, we are happy to say, acquiesced in that Treaty, believing it to be a statesmanlike document, which put a stop to ruinous competition, and brought about a feeling of amity and mutual understanding among the three great powers concerned.

The allocation of capital ships to each power was determined by the leading naval officers of each Navy. It was no mere layman's job. Our own officers, largely members of the General Board of the Navy, knew perfectly well what they were doing; and the public may rest assured that they took very good care to protect the interests of our Navy and see to it that the eighteen capital ships selected would fully equal those selected for Great Britain and were in the proper proportion to those allowed Japan. The press articles seek to persuade the American public that our eighteen ships are inferior to those of Great Britain. Personally, we believe that the advantage, if there be any, lies with us.

Take the single fact that our eighteen ships will carry in the "Maryland" and her two sisters twenty-four of the powerful sixteen-inch guns; whereas the British fleet, for some years to come, will not contain a single one of these great weapons. Again, at the present writing, our three "Marylands" are only from two to three years old, whereas the leading ships of the "Royal Sovereign" and "Queen Elizabeth" class, are from seven to nine years old. Age is one of the most important, if not the most important element in determining the present-day value of a ship. The newest ships of the British fleet, therefore, are not only weaker in gun power, but the ships themselves are older, and, therefore, much further on the road to obsolescence. There is a great advantage held by our fleet, in the fact that our five leading ships embody the lessons in construction taught by the great Battle of Jutland. The leading British ships, on the other hand, are pre-Jutland, and we should remember that the highest naval authorities consider that a post-Jutland ship is from 30 to 40 per cent more efficient than one built before that battle.

We believe that our three post-Jutland 33,000-ton "Marylands" with their sixteen-inch guns, their 13½ to 18-inch armor, and their five anti-torpedo hulls, one within the other, in a fight with three 29,000-ton "Royal Sovereigns," (pre-Jutland ships) would inevitably sink the older vessels. This conviction is based upon a careful consideration of the various offensive and defensive elements which enter into the construction of the "Maryland" and "Royal Sovereign."

These press articles emphasize the fact that we are scrapping thirteen modern battleships. It says nothing about the fact that, before we commenced to scrap any modern ships, that is before France had signed the Treaty, Great Britain had scrapped eighteen modern battleships and seven hundred and fifty other ships of her great Navy, and that with the exception of the Treaty battleships, she had done all this reduction voluntarily. So much for the outstanding feature of the mass of misinformation which has lately been poured out on the public.

The criticisms of Admiral Coontz are of a different character. They do not call in question the Treaty; but they are in fact a severe arraignment of our failure to maintain our Treaty Navy in first-class condition. The boilers of our battleships must have been allowed to fall into a sad state of disrepair, if the ships can make only twelve knots. They should be good for twenty at least. Congress must be generous in appropriations for maintenance. Nothing depreciates so rapidly as a neglected warship. As to unarmored ships, we repeat what we have frequently stated in these columns, that we should build at once an addition of eight to ten first-class cruisers to bring the cruiser tonnage up to the proper strength. Also we should build a sufficient number of flotilla leaders and sea-going submarines.

Finally, we believe that the question of gun elevation has been over-stressed. Beatty outranged the German cruisers by several thousand yards; also he had the speed gage; yet he never engaged at 20,000 to 22,000 yards, preferring to fight at fro n 12,000 to 18,000 yards. Battle practice at 25,000 yards in clear weather under selected conditions may result in excellent target records; but the days when visibility is suitable to a 25,000-yard range are few and far between on the broad spaces of the world's seven seas.

His Honor the Mayor and the Engineers

IF WE were asked to name the most successful engineering work in America, we should be tempted to give that honor to the New York system of subways. Other engineering works may surpass it in certain particulars, but taken as a whole, the New York subway system is unrivaled. In the size of its cars, the length of its trains, their speed, the fact that it is the only city subway provided with separate express tracks, and above all because its fatalities have been only one in so many millions carried, we do not hesitate to place our subways in the premier position as an example of the work of the American civil engineer. Nevertheless, the distinguished Mayor of New York, speaking of the latest plans of the engineers for the extension of the subway system, says "the Transit Commission apparently threw together a set of printed descriptions and maps without any knowledge of what lay under the streets in which they laid down these roads." Now any pronouncement from the Mayor of such a great city as New York on a subject of such importance, should be based upon the facts and should be made with a full knowledge of the circumstances. It should carry weight and conviction; nevertheless, if the Mayor is to be believed, the important work of laying down subways has been done in a haphazard way by a body of men who know practically nothing about the conditions.

And what are the facts. Commissioner Harkness tells us that these plans were prepared by the same engineering staff that made the plans for all the subways going back to the first of them which were prepared twenty years ago.

If this statement of the Mayor is not deliberate misrepresentation, it is an exhibition of gross ignorance It is the latest and most deplorable exhibition of that playing fast and loose with the interests and the reputation of this great city which has marked the present administration in its handling of rapid transit. However, the voting citizens of New York have made their bed and must lie upon it. They are reaping the fruits of that neglect of civic duties, which leads people, on election day, to prefer the automobile to the voting booth.

Lowering the Level of the Great Lakes

EVERY one who considers the case dispassionately, must sympathize with Chicago in the serious dilemma in which it finds itself with regard to the disposal of its sewage, which hitherto has been discharged into Lake Michigan. Now although this is a large body of fresh water, Chicago is also a very large city, and the steady discharge of its drainage, year after year, direct into the lake was bound to become a nuisance and arouse the protests of that part of the population which dwells upon the lake front. The question of defiled waters and water-fronts, which has become a great problem in New York, is now pressing heavily upon Chicago.

A way out of the difficulty has been sought by reversing the Chicago river; diverting its waters through a canal into the Mississippi valley and carrying off the city's drainage by this channel. At the present time this canal draws water from the lake at the rate of about 4000-cubic feet per second; and Chicago is now seeking permission to increase the flow to 10,000-cubic feet per second; thereby getting rid of the whole of its drainage and also widening the channel so as to give an outlet for lake shipping to the Mississippi and the Gulf of Mexico. The scheme, so far as the City of Chicago is concerned, is well planned, and so far as the proposal seeks to increase traffic with the Mississippi it has secured the support of the cities and States that border on that great waterway.

But there is a fly in the ointment. For if that much water is drained out of the lake it will reduce the lake level and thereby bring about some very serious complications which, it is claimed, will seriously affect the navigation of the lakes and reduce the efficiency and capacity of the various lake ports. Not only the American ports and American shipping interests have entered a protest, but the Canadian government is also opposed to the contemplated work. It is claimed that the reversion of this water will lower the navigation depth in various canals and locks such as those at the Sault Ste. Marie and the Welland Canal, to say nothing of various ports whose harbor channels have a limited depth. Protests have also come from the power companies along the St. Lawrence River.

Chicago replies that such lowering of the lakes as has occurred has been due to fluctuations of the rainfall, and that the increased flow through the Chicago canal will have no permanent effect in lowering lake levels. Here is a big problem which must be faced and whose solution will call for very careful planning. We are inclined to think that Chicago will find its best solution in the adaption of one of the modern methods of sewage purification.

Long-Distance Locomotive Runs

AMERICANS are proud of their steam railroad system, and they have every reason to be. Its present perfection is due to the fact that its development has been in the hands of trained and able technical men, who have been left free to plan and build without any governmental or other outside interference with their technical work. Always our engineers are aiming to cut costs by getting the very maximum of performance out of their roadbed and rolling stock. The latest evidence of this is seen in the movement to increase the length of locomotive runs, by putting successive crews on the same locomotive, and thereby cutting down the time which the locomotive spends in the round-house. As an example of this, we have the record run of a special class of locomotives designed for long-distance service on the system of the Southern Pacific Railroad Company. This engine is drawing trains of from twelve to fourteen cars on a continuous run from Los Angeles, California, to El Paso in Texas; a distance of 815 miles. The engine is oil burning, and its tender carries 12,000 gallons of water, and 4000 gallons of oil. The average work of this locomotive is 12,000 miles per month.

Here and There

George F. Mitchell

WE are wont to regard pure food laws as something of comparatively recent vintage. But some of them, at least, are of longer standing than we realize. The Tea Act, for instance, under which all teas entering the United States are subjected to rigid tests, dates back to 1883. All shipments of tea, under this Act, must go to a bonded warehouse, where samples are taken of them in accordance with a careful routine which insures that these shall be fairly representative. These samples go to a board of tea testers working under the Department of Agriculture, and are checked by this board against fixed standards of purity and quality. One would perhaps not picture the job of tea testing and tea tasting as one calling for the labors of seven experts working full time, yet such is the case. As evidence of this, we display herewith the features of one-seventh of the board of testers, Mr. George F. Mitchell, Supervising Tea Expert of the Bureau of Chemistry. In the original, Mr. Mitchell was surrounded by a large amount of the atmosphere of his profession, but in the process of getting him down to thumb-nail dimensions we have had to "crop" all the atmosphere except one cupful.

AN indefatigable research worker and inventor is Dr. Lee DeForest, whose name is synonymous for radio progress. It was DeForest who worked out the problems of pioneer radio in this country. It was DeForest who introduced the third element or so-called "grid" in the vacuum tube and made it the wonderful electrical device which it is today. It was DeForest who took the three-element tube and harnessed it in so many different ways not only for the betterment of radio, but for the marked advancement of wire telephony. It was DeForest who spent year after year on the problem of radio telephony when that problem seemed insurmountable. It was DeForest who carried on radio broadcasting when the only listeners were the startled radio amateurs whose ears were trained to the dot-dash language of the Continental code. And it is this same DeForest who, not content to rest on his well-earned laurels, is now engaged in developing the talking motion picture. Speaking about laurels, Dr. DeForest on more than one occasion has been deprived of the credit due him for his work. In an art so complicated as radio it is quite natural that others should lay claim to credit for certain developments which were originally worked out by Dr. DeForest. A case in point is the "feed-back" or "regenerative" arrangement for the vacuum tube, which has long been the subject of considerable litigation. For years DeForest was deprived of his rights to that invention. But a recent court decision reverses all previous court findings and awards the priority to this invention to Lee DeForest.

Charles F. Marvin

MOST of us can remember the good old days when it was a standard joke that the daily weather predictions were bad guesses, and that the man in the street could profitably "copper" them by going on a picnic when rain was promised, and carrying his umbrella against the announcement of an impending fair day. It's different today; for while we all understand that weather is a flighty thing and is not to be forecast on any basis of 100 per cent accuracy, we put general confidence in the contents of the little box on the upper right corner of the front page of our morning paper, and very largely regulate our conduct according to what it promises us in the way of rain and shine. No little credit for this improvement in accuracy is due to Charles F. Marvin, Chief of the United States Weather Bureau, whose portrait we give. Not alone is Mr. Marvin responsible for many improvements in the routine of the Bureau that make for better accuracy and better service, but he is equally an inventor of parts in his chosen field. His instruments for measuring and automatically recording rainfall, snowfall, sunshine and atmospheric pressure have gone far to put forecasting on a business basis.

Prof. Charles Richet

MORE and more the reports of psychic phenomena which reach us from Europe, and the findings that result from psychic investigation, center about two names. Both these names have appeared in these columns in connection with Mr. Bird's European adventure, and one of them has likewise been seen among the list of our contributors. Professor Charles Richet, ranking head of the department of physiology at the University of Paris, and Dr. Gustave Geley of the Institute Metapsychique International, are the gentlemen to whom we refer; and to point the reference, we annex their photographs. Mr. Bird tells us that both are excellent likenesses of their originals.

Dr. Gustave Geley

WE shall hear more of these researchers before we hear less of them. At this moment, the mediumistic profession—whether genuinely or fraudulently we would not venture a guess from this distance—is booming on the Continent, and one reads almost weekly of a new medium. Now it is Erto, described as shedding from his person a luminescence which baffles Richet and Geley. Now it is Guzik, with the production of extraordinary telekinetic phenomenon. Now it is a Spaniard who bobs up with the ability to see through metal boxes and catalog their content. But whoever it is, these active Parisian investigators are invariably cited either in behalf of the genuineness of the performer, or as having pronounced him fraudulent—or, sometimes, as having been fooled by him.

AN instance of the latter sort is found in the Spaniard with the X-ray eyes. He came to this country with a great fanfare of publicity. What one did not learn until one went to sit with him was that he brought his own boxes—two of them—and would give his demonstration only with one of these. What one next learned, if one were a keen observer, was that one could see the contents of the Senor's boxes just as well as the Senor could, if one but fully identified and faithfully followed the Senor's procedure. It speaks well for our judgment in selecting the members of our own committee for Psychic Investigation, that the only persons, so far as we know, who have seen through the performance of this fraud from overseas on first meeting it, are Drs. Carrington and Prince. We call the Senor by the shorter and uglier name, because that is what his technique marks him for. He bears testimonials—whether genuine we do not know—to the effect that he has "impressed" Geley and Richet; and he presents his performance as genuinely psychic. He is a long step removed from the comparatively innocent type of artist who does his stuff without advancing any specific claims, and permits his audience to explain it as they will—even Houdini is accused, by some spiritualists, of using genuine psychic power in some of his acts!

Dr. Lee De Forest

THAT'S a lovely little word, that term "impressed," which we have used just now; and at the risk of revealing our own game we are moved to expand a bit upon it. We have no doubt whatever that both Richet and Geley were "impressed" by the performance of the X-ray-eyed Castillian, and said so. What they presumably didn't say however, was that they were impressed with his genuinely psychic powers. We are guilty of the same little artifice for gaining a painless exit from the presence of the fraudulent medium, particularly if he has a pestiferously pursuing disposition of the type that demands an expression of opinion from every member of his audiences. "A very interesting performance"; "extraordinary"; "well worth while coming to see"—these are but a few of numerous expressions which may with literal truth be applied to any performance of any type, provided only it be well executed. And it is very amusing how universally the clever fraud will himself fall victim to this little play on words, leaving our presence quite confident of his own importance and with full belief that he has imposed upon us.

NOT the least of the scientific outcroppings of the war is the chlorine-gas method for treating common colds, which has just now come to general attention through its use by President and Mrs. Coolidge, and its adoption by the New York City health authorities. This process is a by-product of poison-gas warfare and experimentation, army physicians having discovered, largely by accident in the first instance, that the breathing of air containing small amounts of chlorine gas cleared up some colds rapidly. The question of its applicability to all colds is still open; and it is obvious that an overdose will aggravate rather than relieve the symptoms. This is not a disadvantage in practice, however, since the most ordinary intelligence would detect the results of overdose before they could become serious. The treatment owes its present advanced status to five years of experiment with monkeys. The attempt to cure tuberculosis has as yet not been successful.

LAST month we stressed, in "Here and There," some of the unusual activities of your Uncle Samuel. After the Public Health Service, from which we then drew our examples, the layman doubtless thinks first of the Bureau of Animal and Plant Industry in the search for further governmental chores of striking character. But one can go much further afield than this without exhausting the possibilities.

We present, for instance, at the extreme end of this page, the portrait of J. Hamilton, official candy-maker to the Federal Government. You didn't know your Uncle Samuel had an official candy-maker? Neither did we, until the camera-man's salesman dropped his counterfeited countenance upon our desk. He works for the Department of Agriculture, striving for perfection in the manufacture of pure, wholesome candy; and already his efforts have meant much to the industry.

J. Hamilton

With the "Limited"

Some Startling Facts and Figures Regarding Our Fastest and Farthest-Traveled Trains

By Charles W. Stokes

ONE does not write one's self down altogether as a juvenile by yielding to the fascination of seeing the trains go by. Especially the fast trains! Next to traveling on the "Limited," the best thing is to watch it—or her, rather, as we prefer to say. Here she comes now, whistling around the curve: in a very few seconds she is roaring through, a towering mass of steel, force, and crude energy, her fires aglow, her stack belching smoke, shaking the station and clattering over the yard switches with their winking red and green signals. And then behind, the long troop of cars, tall, darkened for the night, with goodness knows how many people asleep or how many destinies working towards fulfilment in them—at the rear end, perhaps, the club car still lit, with men smoking, chatting or eating sandwiches—perhaps a few nighthawks sitting out on the observation platform. Yes, the Limited is safe for the night, and we can go home to bed.

The "Broadway Limited"—a 20-hour train between New York and Chicago, covering a distance of 908 miles at an average speed of 45.4 miles per hour

Inside, of course, it may be different. Speed, like many other things, is comparative, depending upon whether you are on the outside or the inside. The Limited may be hitting up seventy or eighty miles an hour; but some passengers will be sure to be yawning because they are not getting there quicker. The passenger, it is certain, sees things from a longer focus. His tendency is to fix his eye on a distant object, which takes much longer to pass his line of vision than would the train itself crashing laterally by the station spectator at a distance of a dozen or two feet. Hence the Limited, with its excess fare, its superfine cars, its palace restaurant, its baths, its valet to press one's pants and thus save precious time at the journey's end, its barber to cut one's hair or its stenographer to write one's mail, may be somewhat of a bore to those who ride it.

The really fast trains of North America are confined to the eastern half of the continent, to a few companies, and to a few "runs." The longest runs are confined, perhaps naturally, to the western half of the continent, chiefly between Chicago and California. Besides these, there are three or four hundred other trains, not quite so fast, which have reached a certain measure of fame as well as popularity, and which have received the dignity of having names as well as the mere numbers which the operating department bestows upon them. A great many New Yorkers, for example, would fail to recognize in the 2:45 P. M. to Chicago, or in "Number 25," the great train which has become almost an institution in the "Century."

The fastest trains of this continent, counting running time from start to finish, are the rival Pennsylvania and Reading Philadelphia-Atlantic City expresses, which average 55.4 miles an hour. Some other celebrated "flyers" are detailed in the list which appears herewith. These speeds, of course, include stops, as well as changes of time from one time zone to another. Between stops a much higher rate of speed may be attained, according to gradients, curves, and weather conditions. One famous train is said, at a certain point in its run, to reach 110 miles an hour, and even suburban trains can be found to pass 70.

Whether or not American railroads maintain for their famous flyers the high speed of, say, ten years ago is a subject that only a very intensive study of their working time-tables would reveal. With the Great War and the necessity for fuel conservation, some of the competitive "limiteds" were eliminated altogether; others were slowed down. The Twentieth Century Limited, for example, is now a 20-hour train. Before the war it was an 18-hour train. As a matter of fact, the present writer, in attempting a compilation of the 300-odd passenger trains which the various companies of the continent feature as the headliners of their passenger traffic, found that the average speeds on runs of varying distances were 35.6 miles per hour for runs up to 250 miles, 32.4 m.p.h. for runs between 250 and 500 miles, 32.3 m.p.h. for runs between 500 and 1000, 31.5 m.p.h. for runs between 1000 and 2000 miles, and 29.2 for runs over 2000 miles.

Given a good track, good weather, a steady hand at the throttle, and good firing, anyone could run a train quickly; the important job is to run it safely and to keep it untangled from the press of traffic running in the same or the opposite direction. It is a stupendous job indeed that faces the passenger traffic manager of a railroad when, having become convinced that the rivalry of competing companies or the growth of business necessitates faster schedules, he sits down with the chief despatcher and tries to clip hours or minutes from the running time of his roaring pets, or to insert new ones. It can be done, of course; but the schedules of an entire system may have to be changed. Some of the factors that pass under discussion are connections at junction points, whether the hour of arrival or departure at terminals is convenient to the traveling public, how it compares with those of a competitor, what equipment is available, passing trains on a single track system, and so on.

On overnight runs between fairly close cities the hour of arrival is not nearly so important as the hour of departure. High speed, in fact, is immaterial so long as these "owl" trains, which carry mostly business men, arrive at approximately breakfast time; but between the train which leaves at 11 P. M. and that which leaves for the same point at 11.30 P. M., the latter will get most of the business, for it permits the traveler to take in a show without having to leave before the final curtain. A case came to my attention recently, too, in which an important trunk line A, the subsidiary of a bigger company B, which was feeding through trains to B and also to a friendly associate C, declined to deliver through trains more quickly to C and thus speed up the A-C run because so doing might hurt the A-B business.

What are the farthest traveled trains? One speaks easily of "transcontinental" trains; but actually there is not one single train starting from either the east or the west coast of the United States that ever reaches the other; and the Canadian systems, even though their main lines are longer, run no through cars from the Atlantic to the Pacific. Nevertheless, the Montreal-Vancouver services of the C. P. R. and C. N. R. may be called transcontinental. Montreal is above tide-water, but is actually connected with it by the St. Lawrence River, and ocean liners dock there, while Vancouver is directly on the Pacific Ocean.

But another test must be applied. What is a through train? Many of these long distance trains undergo an almost complete transformation before they reach their destination. They start with sleeping-cars which they drop at intermediate points; they pick up others. Sometimes they change their diners, or add a club car for part of the run. Sections start from different cities, and are consolidated

(*Continued on page 63*)

Some of America's Fastest Trains

			Miles	Hr.-Min.	Speed
Number 1181	Penn.	Philadelphia-Atlantic City	60	1.05	55.4
Number 17	Reading	Philadelphia-Atlantic City	60	1.05	55.4
Twentieth Century Limited	N. Y. C.	Chicago-New York	978	20.00	48.9
Empire State Express	N. Y. C.	New York-Buffalo	438	9.00	48.5
The Detroiter	M. C.-N. Y. C.	Detroit-New York	690	14.45	46.8
The Pittsburgher	Penn.	New York-Pittsburgh	440	9.35	45.9
Broadway Limited	Penn.	New York-Chicago	908	20.00	45.4
Congressional Limited	Penn.	New York-Washington	227	5.00	45.2
Interstate Special	N. Y. C.	Buffalo-Chicago	540	12.00	45.0
Knickerbocker Limited	New Haven	Boston-New York	229	5.10	44.3
Merchants Limited	New Haven	Boston-New York	229	5.10	44.3
Wolverine	N. Y. C.-M. C.	New York-Chicago	973	22.00	44.2
Southwestern Limited	N. Y. C.-Big Four	New York-St. Louis	1157	26.25	44.1
Detroit Special	M. C.	Chicago-Detroit	283	6.25	44.1
Washingtonian	B. & O.	Philadelphia-Washington	133	3.03	43.6

The Farthest Traveled Trains

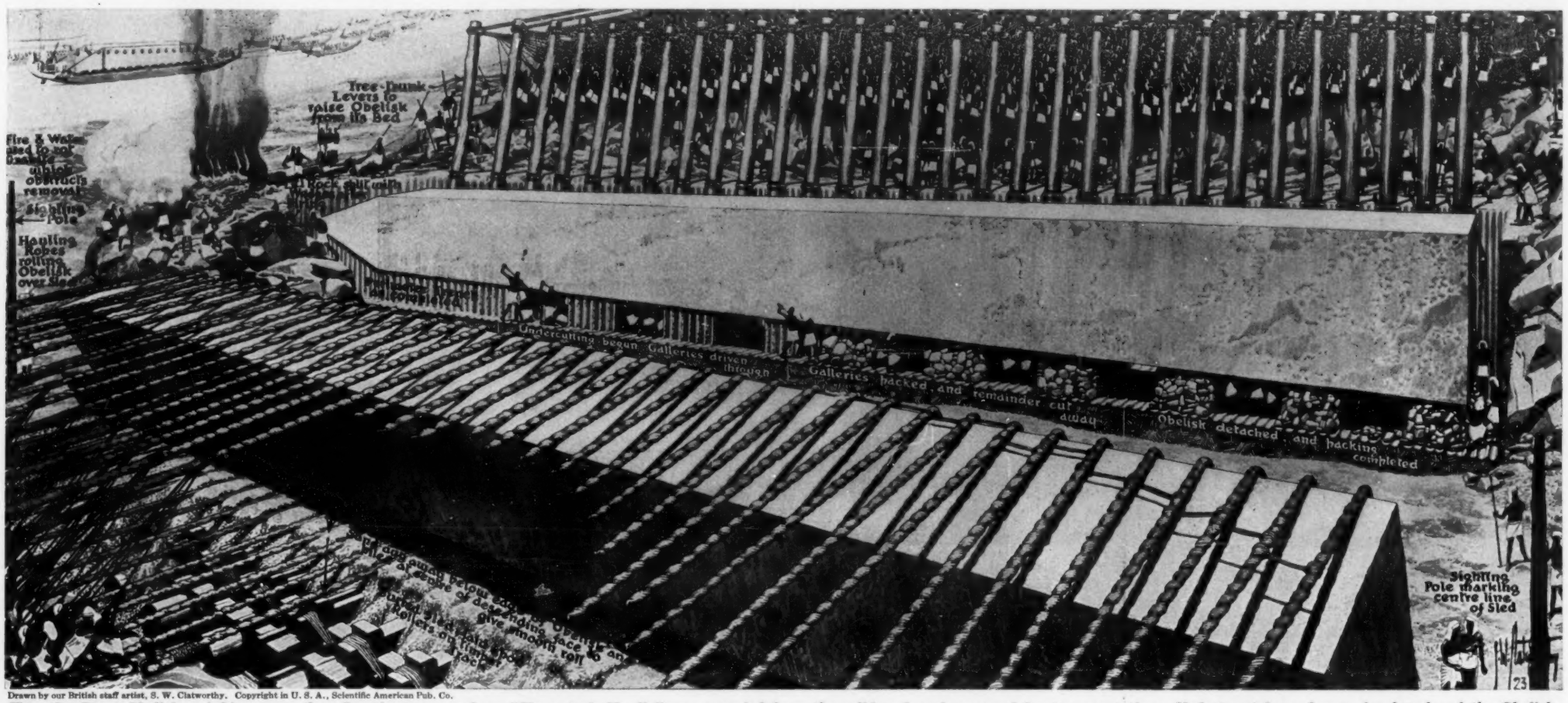
(Over 30 miles per hour)

			Miles	Hrs.-Min.	Speed
Trans-Canada Limited	C. P. R.	Montreal-Vancouver	2885	90.00	32.1
Sunset Limited	S. P. R.	New Orleans-San Francisco	2487	73.20	33.9
North Coast Limited	C. B. Q.-N. P.	Chicago-Seattle	2335	70.00	33.4
Continental Limited	C. N. W.-U. P.-L. A. S. L. S.	Chicago-Los Angeles	2309	73.00	31.6
Los Angeles Limited	C. N. W.-U. P.-L. A. S. L. S.	Chicago-Los Angeles	2309	68.40	33.6
Golden State Limited	Rock Is.-S. P.	Chicago-Los Angeles	2278	68.40	33.2
Portland Limited	C. N. W.-U. P.	Chicago-Portland	2262	70.00	32.3
Overland Limited	C. N. W.-U. P.-S. P.	Chicago-San Francisco	2261	68.20	33.2
Pacific Limited	C. M. S. P.-U. P.-S. P.	Chicago-San Francisco	2261	71.45	31.5
California Limited	Santa Fe	Chicago-Los Angeles	2246	68.35	32.7
Navajo	Santa Fe	Chicago-Los Angeles	2246	71.05	31.6
Olympian	C. M. S. P.	Chicago-Tacoma	2209	71.35	32.0
Oriental Limited	C. B. Q.-G. N. R.	Chicago-Seattle	2207	70.00	31.5

Some Other Famous Trains

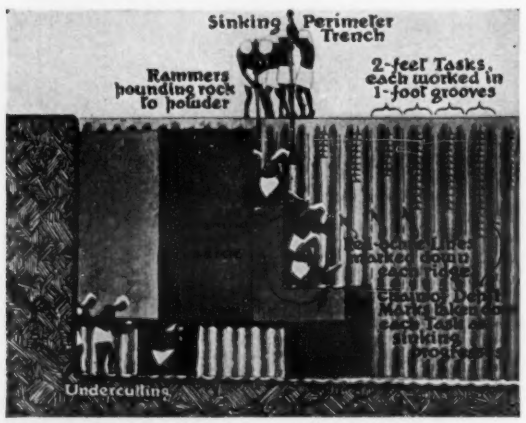
			Miles
Mercantile Express	Penn.	NewYork-Philadelphia	91
Washington Express	B. & O.	New York-Washington	227
Yankee	B. & A.-N. H.	Boston-New York	232
Lackawanna Limited	D. L. W.	New York-Buffalo	396
The Viking	C. N. W.	Chicago-Minneapolis	421
Black Diamond	Lehigh	New York-Buffalo	447
Buckeye Limited	Penn.	New York-Cleveland	577
Clevelander	Penn.	New York-Cleveland	588
Cincinnati Limited	Penn.	New York-Cincinnati	750
International Limited	C. N.-G. T.	Montreal-Chicago	847
Capitol Limited	B. & O.	Baltimore-Chicago	857
Manhattan Limited	Penn.	New York-Chicago	908
Panama Limited	Ill. Ctl.	Chicago-New Orleans	921
Mohawk	N. Y. C.-M.C.	New York-Chicago	973
Royal Palm	Big Four-Southern	Chicago-Jacksonville	1125
Seminole Limited	Ill. Ctl., etc	Chicago-Jacksonville	1133
Florida Special	Penn.-A. C. L.-F. E. C.	New York-Miami	1390

(Above figures corrected from latest time-tables)


Tree-Trunk Levers to raise Obelisk from its Bed
Fire & Water used to cut & make visible obstructs removal
Sighting Pole
Hauling Ropes rolling Obelisk over Sled
Undercutting begun. Galleries driven through
Galleries backed and remainder cut away
Obelisk detached and backing completed
Sighting Pole marking centre line of sled
Rollers on timber track
23

Drawn by our British staff artist, S. W. Clatworthy. Copyright in U. S. A., Scientific American Pub. Co.

How the Great Obelisk weighing more than five times as much as "Cleopatra's Needle" was quarried from the solid rock and prepared for transportation. Unfortunately, a fissure developed and the Obelisk was reduced from 137 feet long to 105 feet and the weight from 1168 tons to 507 tons. It was subsequently abandoned and was recently "excavated" in the quarry

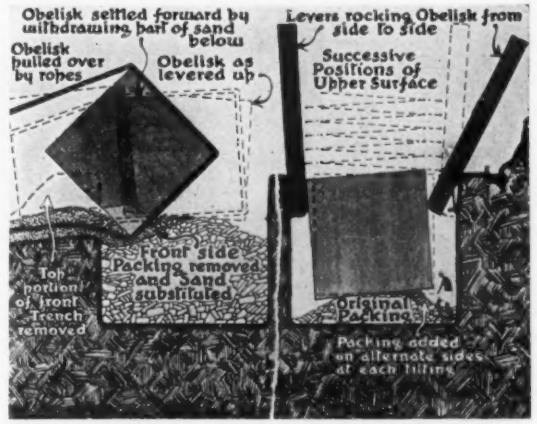


How the ancient Egyptians with primitive tools separated and undercut the monolith

A THOUSAND tons is an immense weight to lift and transport, and would tax the resources of our modern engineers with their powerful tackle and winches; yet the Egyptians were preparing to transport an obelisk 137 feet long, with a base measuring 13¾ feet and weighing 1168 tons. Unfortunately, the enterprise had to be abandoned on account of a fissure which developed in the monolith. This huge piece of stone still lies in the quarry at Aswan and has lately been "excavated" by the Chief Inspector of Antiquities of Upper Egypt, Mr. R. Engelbach, who has just written a book entitled "The Problem of the Obelisks," published here by Doran. The enormous size of this rough-hewn is indicated when we compare it with Cleopatra's Needle, which is only 69½ feet long and which weighs only 193 tons.

The ancient quarrymen sunk test shafts to test the quality of the granite. The top layer of granite was chipped off by fire. The rock was then cleared by splitting, slots being chiseled for the insertion of copper or iron wedges, probably between wooden wedges wetted to expand. A perimeter trench was worked all around the great blank, which was to be fashioned to the shape of an obelisk. This was necessary so as to allow for undercutting, for, of course, the great blank could not be split off until the base was free. About 390 men worked in the trench at one time, 130 being in the trench proper and 260 men using rammers from above. It is estimated that to sink the trench required seven months of twelve-hour days, and the undercutting probably took as long. The undercutting removed part of the granite matrix and the huge blank was supported on false stone piers composed of loose material.

After the blank was entirely detached from the gangue rock and shaped more or less roughly, it was necessary to get it out of the pit in the quarry, the top portion of the front trench being ultimately removed. Sand was then substituted for the packing. Levers made of trees, the sections being twenty to thirty feet long and two feet in diameter, were used on each side. Fifty men to each lever pulled in unison and all the levers moved at once so that the great stone swung from side to side and was raised higher and higher by the packing until it was raised far above the surface, as shown in our small right-hand drawing. Ropes were now attached, or rather looped, arcund the obelisk, as shown in our large drawing, and it was pulled over by 6000 men until it reached the bottom of the slope, where it rested on a huge sled laid upon rollers on a timber track. When it reached its destination, the obelisk was erected by a sand funnel, which seems to have been the most feasible method, since the ancient Egyptians could not have known the methods used in erecting the obelisks at Paris and New York.


Obelisk settled forward by withdrawing part of sand below
Obelisk pulled over by ropes
Obelisk as levered up
Levers rocking Obelisk from side to side
Successive Positions of Upper Surface
Top portion of front Trench removed
Front side Packing removed and Sand substituted
Original Packing
Packing added on alternate sides at each tilting

How the Obelisk was rolled over after being raised as shown on the right

THE PROBLEM OF THE OBELISK. HOW AN 1168-TON OBELISK WAS QUARRIED AND TRANSPORTED. AN OLD QUARRY GIVES UP ONE OF THE SECRETS OF THE AGES

Our Abrams Investigation—X

Two More Blood Specimen Tests and a New Offer of Co-operation From the Electronists

By Austin C. Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

IN DIAGNOSIS, "the E. R. A. can not only determine positively the existence of conditions of malignancy or infection such as carcinoma, sarcoma, tuberculosis, acquired and congenital syphilis, colisepsis, streptococchemia, etc., etc., but can determine them in their very incipiency, and furthermore can localize them definitely in any part of the body. And, perhaps most amazing of all, the degree of their virulency can be mathematically determined and, as improvement is made, the degree of improvement can likewise be measured.

"I fully realize that this statement is of the most tremendous significance and I have carefully weighed every word of it. In diagnosis alone, the Abrams concept offers to the world by far the most accurate and useful method ever propounded. . . ."

Thus writes Francis A. Cave, D.O., M.D., in *Pearson's Magazine* for July, 1922. Dr. Cave is a practitioner and instructor in the Electronic Reactions of Abrams technique, and when he speaks or writes he does so with the full authority of the electronists. Furthermore, this statement, and many more like it, is being handed out to the American public in the form of reprints from *Pearson's Magazine* and as original booklets and pamphlets. Surely the statement is clean-cut, positive and, evidently, final. There is nothing here to suggest uncertainty. The technique is presented as a finished piece of work, long since past the experimental stage. We are promised what amounts to health engineering, so to speak—the handling of human ills with that same precision which marks the many branches of modern engineering.

Hence this committee must be pardoned for its surprise and keen disappointment over the results of several series of blood tests made during the past few months. Whatever may be the wonderful accuracy claimed for E. R. A. diagnosis in everyday practice, it is a plain, cold fact that this accuracy cannot be demonstrated before any body of impartial, cool-headed investigators. Indeed, E. R. A. technique does not lend itself to scientific methods of investigation; for the more scientific becomes the investigation the poorer and more exasperatingly evasive are the E. R. A. reactions.

You are told in E. R. A. literature about the remarkable accuracy of E. R. A. diagnosis. You are cited case after case of diagnosis from so-called "blind" specimens, in which the electronic diagnostician had no contact with the patient other than the blood specimen. Yet when the electronic diagnosis was compared with the findings on the operating table, the electronic diagnosis was found to be startlingly accurate. And such cases are cited in great numbers for, if there is one thing which has bolstered the E. R. A. cause, it is the claim of mathematical precision in diagnosis as compared with the cautious and often non-committal diagnostic procedure of the orthodox practitioner.

The E. R. A. diagnostic technique does not fare so well under test conditions. At first the E. R. A. and other electronic workers were reluctant to submit their technique to our tests, but of late several of them have cooperated with us in this work. At various times we have endeavored to get electronists to examine blood specimens from known clinical cases, in order to compare their findings with the known facts; but such tests have not been looked upon with favor by the electronists. Even the late Dr. Albert Abrams himself persistently refused to undertake such a test, because, as he stated, the electronic findings did not necessarily agree with the clinical facts. In which event, of course, we would be asked to accept the electronic findings as the true picture of the blood donor's condition, while ignoring the obvious symptoms of the case.

So we have had to formulate simple tests which would serve to check up E. R. A. findings against themselves. Thus we have prepared for various electronic diagnosticians a set of six blood specimens of which three are of the same blood, and the three others from three different bloods. In each test the diagnostician has been told that three specimens are of the same blood, and the three others are of different bloods, which is more than fair.

The first series of blood tests was described in our last issue. This series was undertaken by accredited E. R. A. diagnosticians working with genuine E. R. A. equipment. As was pointed out in our report, these men have spent over a year investigating and studying and mastering the electronic technique, and have prepared a well-known report on their findings which, to date, are highly favorable to the E. R. A. cause. This report is being extensively used by the E. R. A. men as an endorsement of their work. Nevertheless, our findings go far toward proving that these well-intentioned diagnosticians have either been led astray in their search for something new to add to their own technique, or that they are knowingly and intentionally falsifying their electronic experiment reports. We, personally, prefer to accept the former alternative.

An interesting study: Students from all parts of the world attending the E. R. A. course given by the late Dr. Albert Abrams in his San Francisco class room

Following close on the heels of the first series of blood specimen tests, we have made two other similar tests, one with a very well-known E. R. A. man who, while not a doctor, has been conducting an electronic clinic with the cooperation of skilled electronic practitioners, and the other with a regular Abrams practitioner whose name is often mentioned in E. R. A. circles as a skilled hand and authority in this work. Both these collaborators are down South.

The results from the first test of the two mentioned above indicate that two identical specimens and an isolated specimen were grouped together. On the basis of mathematical probabilities, this is little better than pure chance, and the accurate grouping of two identical specimens is considerably offset by including a third isolated specimen. Furthermore, when the "ohmages" for the various specimens are compared with those found by another electronist who worked with the same specimens, there is a discrepancy between the respective findings which is nothing short of glaring. Thus the Southern gentleman's findings for Specimen 4, 5 and 6 show the following: "Reaction for acquired and congenital syphilis, T. B. through both lungs, the right being heavier. Sarcoma reaction scattered through right lung, heavier at top." On the other hand, the findings of another electronist show no T. B. for Specimen 4, no T. B. for Specimen 5, and 0.08 ohm for Specimen 6. By the same findings we learn that Specimen 4 has no sarcoma, Specimen 5 none, and Specimen 6 none. And so it goes; for we have yet to find electronic diagnosticians getting reasonably similar readings for a given blood specimen, such as their usual claims would lead us to believe. It apparently makes a big difference whether the patient goes to Dr. A. or Dr. B or Dr. C, so far as his diagnosis and treatment are concerned.

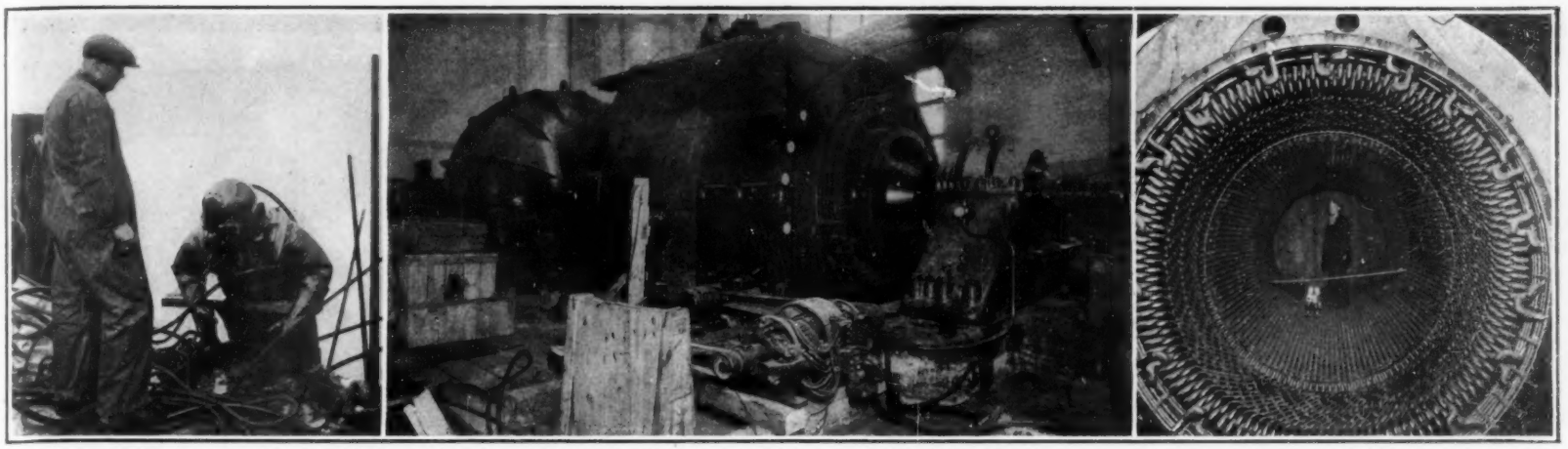
The results of the second of the two tests above mentioned, using a different lot of specimens, grouped Specimens 3, 5 and 6 together, whereas our records showed 1, 2 and 5 to be of identical bloods. Thus our second Southern collaborator has scored a total failure. His readings, as compared with those of another electronist for the same specimens, are just as divergent as in other instances. In his letter of transmission he states: "The samples were not protected by black paper as they should have been and there may have been contamination. You really should see to it that these samples are wrapped in black paper, and that there is no writing nor typewriting in the same envelope with the blood sample. If you should want me to test further for you, I much prefer that the samples be protected in that way."

All of which is presented here for what it may be worth. The mathematical certainty of the Abrams method of diagnosis of which we have heard and read so much, is not always apparent, so it seems to investigators, especially when that method is under rigid test. And by the same token an investigator often shudders over the prolific possibilities of error in everyday electronic diagnosis, in view of his talks with E. R. A. men under test.

And now we come to what must be considered the supreme test of E. R. A. technique, so far as this investigation is concerned. For the past month or more our committee has been working with a doctor who stands well toward the top of E. R. A. Indeed, when this doctor came before us and offered to undergo our tests and aid us in finding the elusive reactions, he made it perfectly plain that his work for us would have to stand or fall on its own feet. He told us he was a leading E. R. A. exponent; his technique was the simon-pure Abrams brand, with the latest developments included; the apparatus to be employed was our own Abrams outfit, together with Leeds & Northrup precision apparatus which we provided at his request; and he was to be given ample time and proper facilities so that he would have no excuses to offer for ultimate failure, if failure it should be. Unfortunately, our policy of avoiding the mention of any names in this investigation prevents us from giving this doctor's name, but all names and findings back of these reports presented month by month, are included in our records. After all, for the broadest purpose of this investigation we are interested in the technique rather than in individual practitioners.

In all, there have been six formal sessions with this doctor. The first session required over two hours, the doctor endeavoring all this while to demonstrate to Mr. Bird of our staff the occurrence of the reactions. The subject or reagent in this case was the doctor's niece. Bird felt variations in the action of the glass rod, to be sure; but he was unable to connect them

(Continued on page 64)



Left: One of the divers who went into the cofferdam while it was flooded, and cut the sheet-steel piling by means of an electric arc. *Center:* Mammoth steam-electric generator which had to be assembled at a point whence it could be floated on barges to the plant; carrying it by rail or truck was out of the question. *Right:* The stator, or non-revolving part of the generator, with a man standing erect inside. This piece is a five month's assembly job

Three views in the new steam-electric power plant in Brooklyn, the largest of its kind in the world

A Still Larger Power Plant

THE massive walls of the world's largest steam-electric generating station, owned by the Brooklyn Edison Company, are completed. This plant is located on Hudson Avenue at the East River, in Brooklyn. The boiler-house and the switch-house are enclosed; the turbine room is finished, glass having been placed in the windows which are enormous in size.

The new power plant, when completed, will consist of four units, each unit including eight huge steam boilers, and two 50,000 kilowatt turbo-generators. Thus the total installed capacity will be 400,000 kilowatts, or about 540,000 horsepower. The first turbine was completed and turned over on March 4, 1924, while the second unit and the house turbine are practically assembled. In the basement both mammoth condensers have been erected and are being connected to the two circulating pumps of 50,000 gallons per minute capacity. Each of the condensers contains 51 miles of tubing through which the cooling water will be forced by the giant circulating pumps.

The three feed pumps which will be used to force water into the boilers have been set in place. Two of them will be used ordinarily, the third acting as a spare in case of accident to one of the other two, thus carrying out the general design of the entire station, which provides for at least one alternative for every important operation in order to insure continuity of service. In the boiler room, the eight large boilers have been assembled. The automatic stokers to burn the coal under these boilers are completed. The steel casings, lined with firebrick inside, in which the great fires will consume six tons of coal per furnace every hour—these too are finished.

The steel flues, which will convey the gases and smoke to the stacks, after they have given up most of their heat to the boiler tubes, are built and in them have been placed large cast-iron cinder-catcher basins which will be filled with water, so that as the gases pass over them, the cinders will drop out and be flushed from the basin any time.

The two giant steel stacks are now completed, piercing the skyline to a height of 370 feet from the ground, which dwarfs everything even along that part of the waterfront where high stacks and high buildings are numerous. Inside the stacks, where the area is equal to that of a large room, workmen have built a lining of brick, which will serve to protect the steel from the acids contained in the gases.

Progress has also been made under the ground. The enormous discharge tunnel, which is 15 feet wide by 18 feet 8 inches high, and which will ultimately handle 800,000 gallons of water per minute, has been built and cleaned out. The mammoth screen well, which was built inside the largest cofferdam ever attempted in deep water subject to strong current, is finished. An unusual method was used to remove the cofferdam as the pressure of the water would not permit workmen to go in and cut the piling while the cofferdam was dry, so the cofferdams were flooded, and a diver was sent into the cofferdam with an electrical connection to the outside. He then applied a tool to the steel sheet piling—and as the other end of the wire was connected to the generator in a nearby power plant, an electric current was set up through the wire in the cofferdam, and the tool in the hands of the workman—or diver. Then, when he felt the "pull of the flowing current" of electricity acting on the sheet piling, he would withdraw the tool a sufficient distance, to form an arc, and in this way, by repeatedly forming an electric arc, the piling was cut.

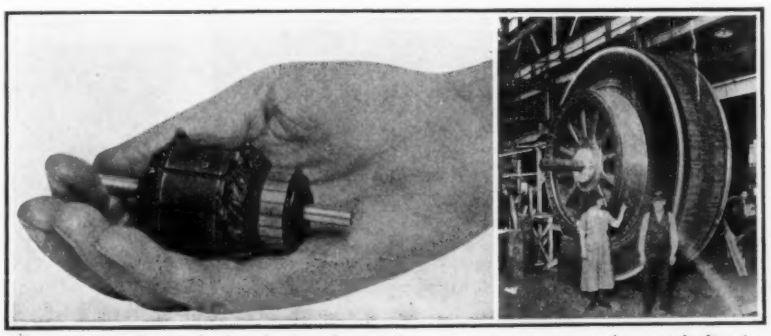
As the bases of the stacks are 112 feet above the basement, the tops are 370 feet above the street. They are constructed of rings, each ring consisting of four sections, the top of each ring being riveted to the inside of the one above it. Each stack has in it about 240 tons of steel.

Erection of the two stacks was carried on from platforms, one platform being on the outside, and was suspended by two wheels which ran along the top of the ring from which it was hung. The other platform conformed to the inside diameter of the stack and was suspended by chain blocks fastened to the top of the ring. At the center of this platform was a mast and arm of sufficient height to allow a section to be placed on the ring above that from which the platform was suspended.

When three sections were set, the outside platform was picked up and placed on them and the fourth section put in place. At the same time the chain blocks were moved up, one by one to the new ring, and when all had been placed in the new position, the inside platform was pulled up opposite the rivet holes, the outside platform rolled into place and riveting started.

The Brooklyn Edison Company on January 29th, brought to the new Hudson Avenue Station, one of the largest single-shaft electric generator parts in the world. The generator, which has just been shifted into position in the power house, is a 67,000 horsepower steam turbo-generator capable of furnishing, alone, sufficient light for a city of 100,000 population.

The huge structure, which weighs more than 250,000 pounds, was assembled at the Hell Gate Station of the United Electric Light & Power Company. On Saturday, January 26th, the generator stator was ready for shipment to the Hudson Avenue Station. It was rolled out on the dock at the foot of East 134th Street, Manhattan, and then prepared for the second lap of its journey down the river. The following Tuesday, huge derricks and cranes moved the 130-ton mass into position on a barge and as soon as tide conditions were thought favorable, the stator was floated down to the Brooklyn Edison Company's wharf at Hudson Avenue.



The lady in the right-hand view holds the smallest armature in proximity to the world's largest; and at the left, we give the little fellow a chance to be seen on its own merits

At Hudson Avenue Station a great crane again raised the machine from the barge and placed it upon the pier. After being placed on the pier, the work of rolling the generator into position in the power station began. When it is completely installed, and the steam driving unit is connected, the generator will represent an investment running up into the hundreds of thousands of dollars.

The electric generator unit alone is 16 feet long and 18 feet high. No railroad car was big or strong enough to bring a mass of such weight from East Pittsburgh, Pa., to New York or even from New York to Brooklyn. It was, therefore, decided to assemble the machine at the Hell Gate Station where, it was said, conditions were as good for the work as at the East Pittsburgh manufacturing plant.

Eight men worked day and night for five months placing the 120,000 pieces of steel, each 14/1000 of an inch thick, into position. The almost innumerable parts when clamped together form practically a solid mass. They form the magnetic structure of the stator and are of special alloy steel.

One of the chief problems in a machine of this type is to carry away the surplus heat from the coils so that the insulation will not deteriorate in use. The energy from the heat generated around these coils is sufficient to heat 100 trolley cars on the coldest day. To cool the machine, a blower attachment forces cold air into the ducts throughout the machine at the rate of 75,000 cubic feet a minute. In 24 hours, this amounts to more than 15,000,000 pounds of air.

The shaft of the generator which is 28 feet long, carries a revolving field weighing 120 tons, or nearly as much as the stator or outer shell itself. The field rotates 1200 times per minute. The field is six feet in diameter and therefore, the speed of the field at the surface is four miles per minute.

Among the materials used in the assembly of the generator are cast iron, cast steel, forged steel, rolled and drawn copper, sheet mica or isinglass, linen tape and varnish. Mica insulation is used to withstand the high temperatures within the machine which must not exceed 230 degrees Fahrenheit.

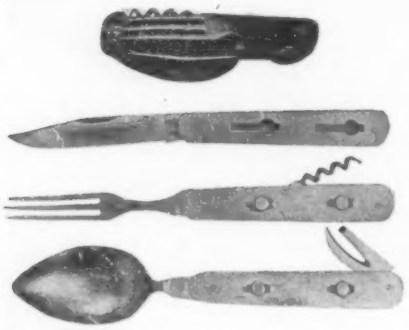
The strongest available flat car in the Pennsylvania Railroad system was selected to carry the rotor.

A Study in Electrical Contrasts

A STUDY in armature contrasts is offered in this photograph which shows one armature weighing 96,000 pounds and a second one, equally complete, weighing 6¼ ounces. Both armatures were assembled in the same building at the great Schenectady electric works.

The huge piece of apparatus is for a motor which is being constructed for use in a steel mill of Detroit's big flivver plant. The motor of which it will be a part will develop 4500 horsepower, and the armature will revolve 67 times per minute.

The tiny winding the young lady holds in her hand was rewound by the service department for use in a small blower in the works hospital. The diameter of the large winding is 13 feet 4 inches; of the other, 1½ inches. The young lady in the right-hand view is holding the tiny armature in her hand.



Camper's combination of knife, fork, spoon, can-opener and corkscrew is a necessity if space is limited and weight is to be conserved. The handle is of red fiber and the utensils are of Swiss steel, plated with nickel. It readily divides itself into three articles as shown in our illustration. This combination set is provided with safety catches to lock securely in position the implement in actual use, so that it cannot fold back and cause injury to the user.

The golf ball marker marks the owner's initials on golf balls. Two, three or four initials can be marked. This should end disputes on the links and John D. will get his own balls

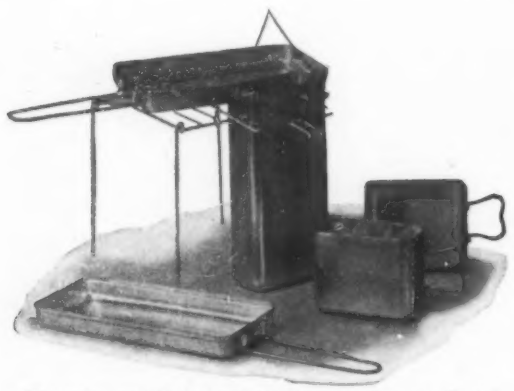
Did you ever try to light a match after being out in the woods in the wet? A water-proof match box will keep matches in good condition. They are inexpensive, one of those shown costing only as much as a medium priced cigar. Perforated cap screws inside top and can be used for salt or pepper

Just as the roll part of the usual roll top desk is flexible, so is this table which is made up of narrow strips of wood covered with leatherette. There are no loose parts to mislay, and best of all it can be rolled up and put in the khaki-carrying case

VACATION is here; it is the time for us to forget the workaday world and its worries; it gives a sweet sense of relief and contentment. To the city man there comes a time when the great town wearies. Visions of green fields, far-rolling hills, tall trees and swift streams. Free life in the open calls, and if we are reasonably prepared with auto, canoe, tent and camping equipment, we are reasonably sure of a good time. The rod and gun will supplement the supplies which have been brought along. Broadly speaking, there are six varieties of camping. First the permanent camp, then we have canoe, pack horse, tramping, forest cruising, and automobile camping. All of them are enjoyable.

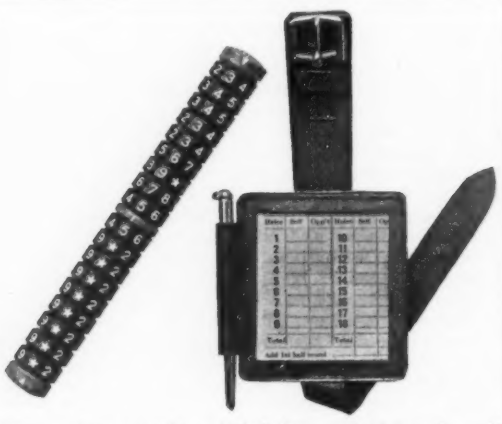
The Re-tee golf device can be used in the house where space allows full swing without danger of smashing things. The use of this indoor device improves the drive materially. Above is a pair of interlocking knife and fork which fit into each other so that they can be carried in safety

CAMPING is now generally of two kinds, either motor camping or canoe camping. For the auto rambler there is no hotel, no bell boys, no tips. Just a good tent and camping accessories, and the open trail leads from the crowded speedways into the haunts of men and women who love the outdoors. The auto rambler follows along the highways and byways, enjoying the hills, the brooks which invite the fisherman, and as night comes on the tent is set up and the best meal in the world is soon in the making on the wonderful gasoline stove. Canoe cruising is equally fascinating. Everything is graduated for the type of excursion planned, and the ability to carry heavy loads is considered very carefully when the outfit is secured.



The pocket cook kit is for those off the roadhouse trail, and furnishes an ideal emergency kitchen. There is a folding broiler with supports which thrust into the ground, two frying pans with detachable handles, and two drinking cups made with detachable handles; yet all go in the pocket

Tommy Green and Sissie Lofter. A golf course on the parlor rug. This golf game for indoor golfing is played with clubs resembling regular clubs which fit into hands of miniature player Tommy Green or Sissie Lofter, the little articulated and realistic players of wood, are so contrived that he or she can, at the will of the player, execute a shot with the tiny club held in the hands of Tommy or Sissie



Here we have a totaler golf indicator at the left and a golf score card for the wrist on the right. With the former the indicator wheels are set with column of stars in line with arrows. After playing the first hole, turn the first wheel to show the score. Second hole under first and so on. It is clever

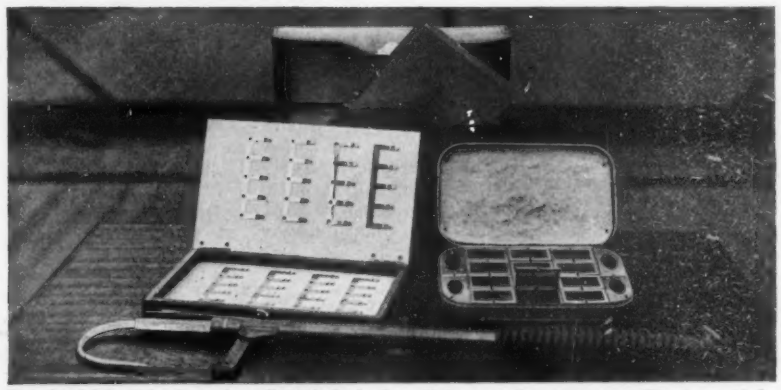
Collapsible buckets are made of waterproof canvas and afford a ready means of carrying water to the camp or car

The gasoline stove takes much of the worry out of camp cookery and as automobiles and camping are intimately connected these days, the supply of fuel often comes from the tank

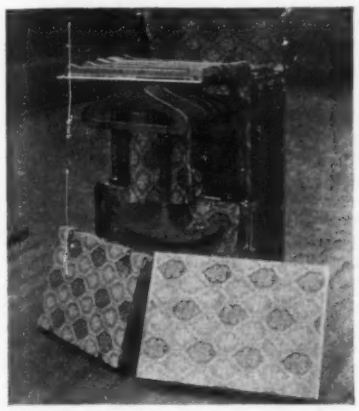
This stove folds up and carries like a suitcase and can be unlimbered in an instant and set frying the slices of juicy bacon

THE CALL OF THE GREAT OUTDOORS—AND THE ANSWER BY THE INGENIOUS INVENTORS

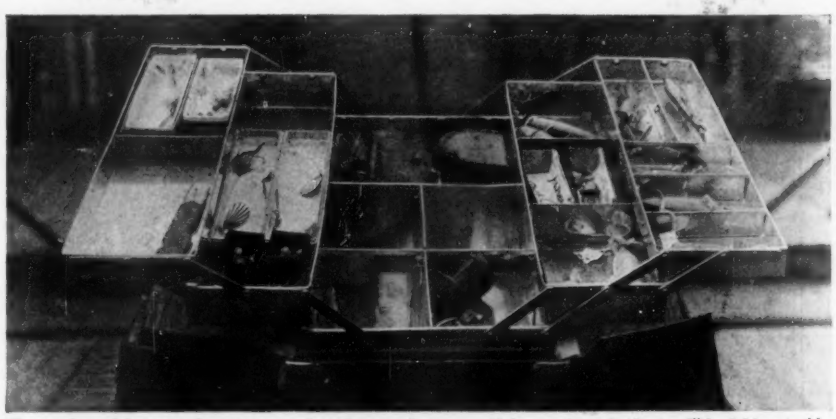
The tent cot is a folding cot with a top of waterproof canvas. It opens on both sides for a person to enter. There is perfect protection from wind and rain and ventilation is secured from the ends. You are raised off the ground, thus doing away with one of the discomforts of camping



Does he fish? If he does, these English fly books will interest the sportsman. Two types of fly boxes are shown both in aluminum. The one on the right has twelve compartments with spring lids which pop open at the touch—and there is your favorite fly. The English gaff-hook is guarded

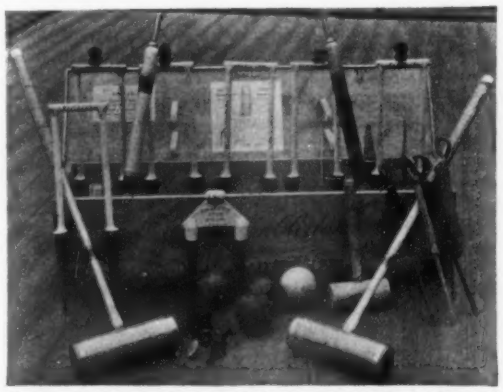


This wardrobe trunk has so many clever devices for saving room that it would care for the needs of two very comfortably

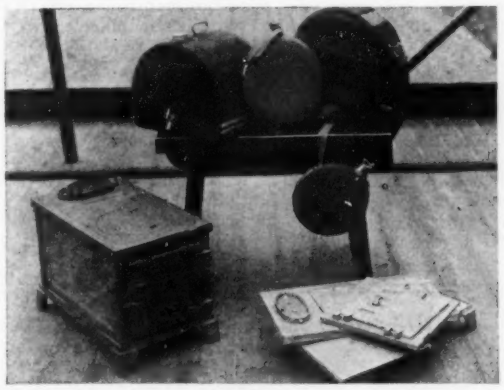


The modern fisherman does not care how he spends money if he can get the best. This fishing tackle satchel folds out and out again until everything is in sight without having to lift trays. If good Isaac Walton at Shallowford could see this set he would be bewildered as to its precise application.

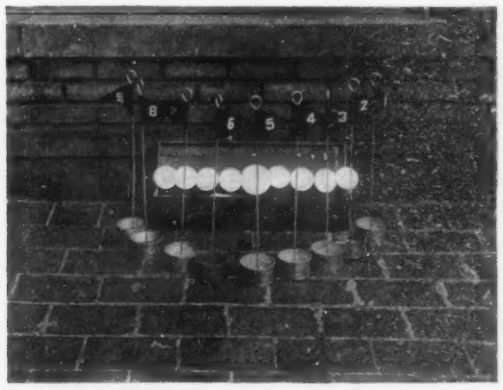
Hikelite is the simplest to erect and can accommodate either one or two persons depending on the size. There is a ground cloth



Croquet de Luxe. This set which comes from England would set you back some ninety dollars, but it will last 1000 years, for it is unbreakable and is so sturdily English that it charms by mere massiveness. Croquet is a nice game and is popular



Stoves and canteens. "Not-a-Bolt" is a stove for camp use which can be put together without wrench or screwdriver. The parts fit so nicely that we can have a real usable stove which will not collapse while the welcome dinner is being prepared

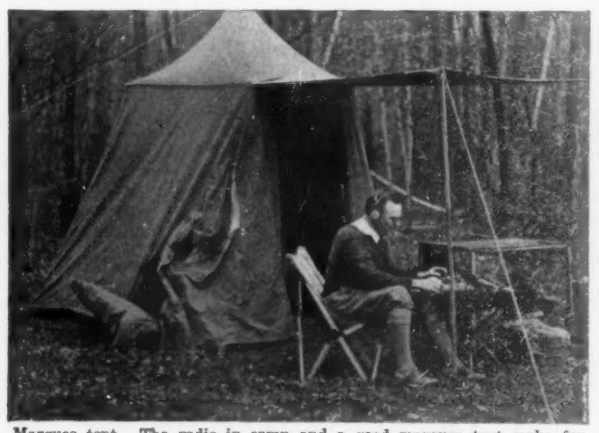


Miniature golf is played on the lawn. The cups are sunk in the ground and the game is played like on a regular nine-hole course. This gives you a portable golf course right on your own lawn and you change the links at will

We are indebted to Abercrombie and Fitch for most of our pictures

A Toledo fish pole. We have all heard of the Toledo blade and now the Toledo fish pole. It does not come from Spain, however, but is a fine specimen of the maker's art for it can be bent like a whip without injury to the highly tempered steel rod

The rolling dumb-bell. This is an ingenious device for one's "daily dozen." It is like an exaggerated spool with free ends which are rubber-tired and rotate freely



Marquee tent. The radio in camp and a good marquee tent make for comfort and pleasure. Tents of this type are simple to erect and can be carried on the running board of a car. They measure 8 x 8 feet on the ground and the eaves are six feet high. The weight is 60 pounds

THE CALL OF THE GREAT OUTDOORS—AND THE ANSWER BY THE INGENIOUS INVENTORS

Repairing the "Shenandoah"

Replacing the Nose Cap and Rebuilding the Stabilizing Fin Restore the Naval Dirigible

BY THE time this issue is on the newsstands, the very serious damage done to the "Shenandoah," when she was torn loose from her mooring mast early in the year, will have been made good, and she will be once more in service. A recent visit to the Lakehurst Naval Hangar has enabled us to gather additional data regarding the behavior of the ship during the extraordinary wind which swept over the field, and to give the fairly unanimous opinion of her officers as to the succession of events which led to the carrying away of the ship and the partial wrecking of her structure.

It is now established, largely on the testimony of one of the ship's officers who was near the stern of the "Shenandoah," that the trouble began with the tearing loose of the covering fabric along the edge of the upper stabilizing fin. The four fins are huge affairs and far larger than the layman would imagine when he sees one of these great ships in the air, where the fins are dwarfed by comparison with the vast bulk of the vessel itself. The wrecked fin was about twenty-five feet in height by seventy-five feet in length, and its purpose, in common with the other three, was the twofold one of carrying the vertical and horizontal rudders and providing sufficient area to stabilize the ship and prevent its "rolling," or rotating about its longitudinal axis.

That the covering fabric, if it gave way anywhere, should have begun to tear above the leading edge of the fin, was not unnatural; for it has frequently happened that in high-speed flying planes, the fabric has commenced to tear at the leading edge, particularly when a plane acquired excessive speed when diving to escape or attack an enemy.

When the canvas was ripped at the front of the fin, the blast of wind entered and, exerting great pressure, blew most of the fabric away from the frame, at the same time partially wrecking the metal frame work. As soon as this happened to the upper fin, the great wind pressure on the lower fin began to exert a powerful turning moment, tending to rotate the "Shenandoah" about its longitudinal axis; and this is exactly what happened just before the ship was carried away from the mast, as testified to by the crew who were aboard the ship.

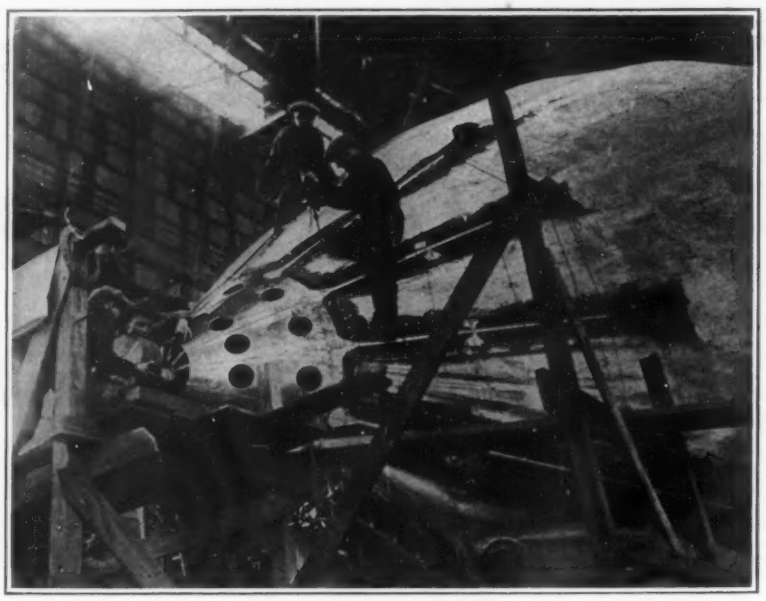
To prevent any heavy torsional stresses in the frame of the ship at the point where her nose is made fast to the mooring mast, the cup-and-cone locking arrangement is provided with ball bearings which, theoretically, should have allowed this rotation of the ship to take place freely. It is believed, however, that this element did not function properly and became more or less jammed. This resulted in a heavy twisting stress on the nose of the ship, which gave way, as we explained in a former issue, immediately abaft the sheet-metal nose cap. It was considered by the staff at Lakehurst, that the conditions of the wreckage showed evidence of "a pull and a twist" at the moment of the disaster. It should be noted, just here, that not far from the mooring mast is a meteorological station where the record shows that the heavy gust which carried the ship away reached a velocity of seventy-two miles per hour.

Prevention of another disaster of the kind is being sought in the direction of an automatic release, which will let go when the pressure exceeds that, due to a wind of a certain maximum velocity; say forty to forty-five miles per hour. Her officers claim it is just as logical for the "Shenandoah" to let slip her moorings in a gale as it is for a ship of the sea to do so in heavy weather and make for the open. They are, of course, the best judges of this; but we are still of the opinion that it would be the part of prudence so to strengthen the bow of the ship that, if the automatic release failed to function, or when the ship was exposed to a sudden gust of great violence, there would still be sufficient structural strength at the bow to carry the ship through the emergency without damage. The method of cable reinforcement running back from the bow, which we suggested in our April issue, would be difficult to install; since the apex of the triangular longitudinal members lies at the surface of the hull and not, as we presumed, within it. We believe, however, that the suggestion is worth further consideration by the Construction Corps.

In repairing the "Shenandoah," the original sheet-metal nose has been rebuilt in place; its connections with the abutting ends of the longitudinal has been reinforced; and special attention has been paid to the re-design of the rotational bearings.

In repairing the broken stabilizing fin, an additional number of light stays has been built in place intermediately with the main A frames. This was done to provide a more complete support for the covering fabric and prevent the violent flapping which, in part, is believed to have been responsible for its being torn loose from the frames.

Outside the fractures to the frame work at the bow and stern, there were no other serious injuries to the ship. The gaping holes which appeared under her hull were caused by dropping tanks of gasoline and other weights in order to bring the ship up when she dipped after breaking loose. These holes have been re-covered, and the long strips of outer fabric torn from her bow have been replaced. An important change in the ship, however, has been made by removing one of her six motors. The motor, which was installed in the after part of the pilot car, has been taken out and the space allotted to a more powerful radio outfit and accommodations. The weight thus saved will be put into gasoline, and the cruising radius of the ship will thereby be markedly increased. There will be a certain loss of speed when the ship is opened full-out; but the occasions on which maximum possible speed will be called for will be very few; and it is considered that the increase in cruising radius at forty knots is a more valuable military asset than the few knots at maximum speed resulting from the use of six as against five motors.



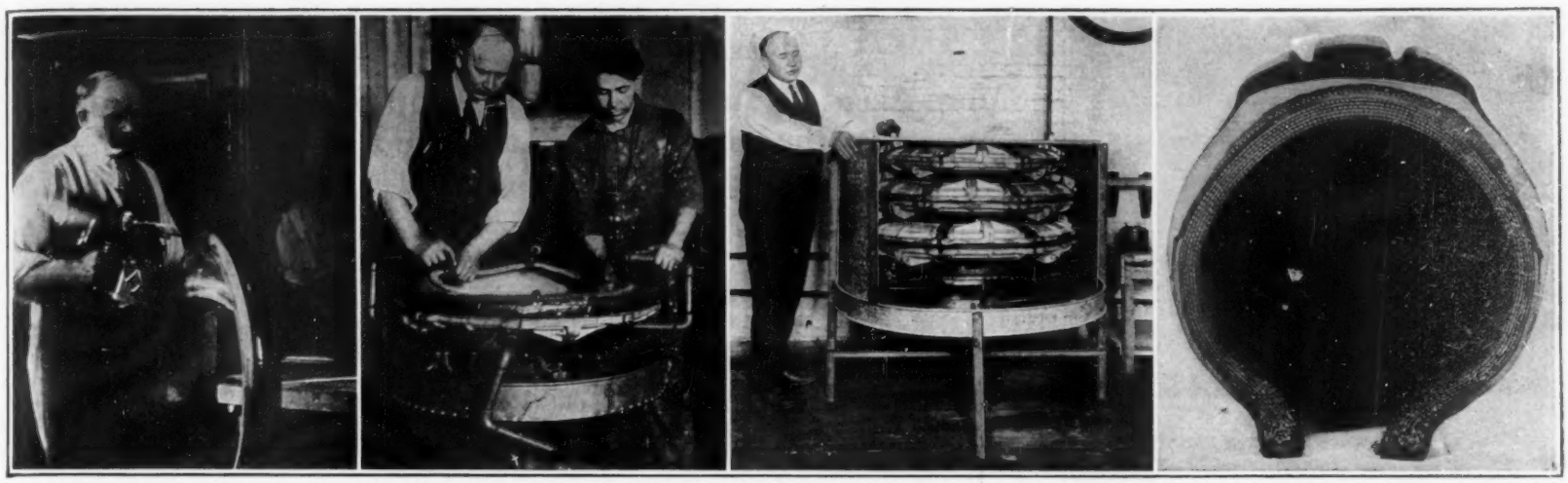
This shows the bow of "Shenandoah," with the metal nose cap, which was torn out of the ship, riveted back in place

THROUGHOUT the naval and military history of the United States there has been evident a lack of continuity of policy, with the result that we have always been in a state of chronic unpreparedness. We have alternated between furious and extravagant activity at the threat of danger and inexcusable neglect when the crisis had passed. In the present post-war period the nation is in danger of falling back into the usual attitude of complacent indifference; and nowhere is the danger more apparent than in the field of naval and military aeronautics. Economy is the watchword of the hour, and properly so; but we must be watchful against carrying our reduction too far. There are certain legacies of the war which should be carefully maintained. Conspicuous among these is the fine air station, with its superb hangar for dirigibles, at Lakehurst. This is the largest hangar of its kind in existence, and in the "Shenandoah" we possess the only dirigible to be found anywhere in active commission. In a few weeks, the "Shenandoah" will be joined by "ZR-3," a larger and faster ship, embodying the very latest improvements in the art of dirigible construction. The $3,000,000 hangar, with its two fine airships, and the spacious landing field with its steel mooring mast, constitute an unique property, unmatched elsewhere, which should be carefully maintained and developed.—THE EDITOR.

It is needless to say that the personnel, officers and men alike, are enthusiastic over the virtues of the helium gas with which the "Shenandoah" is inflated, and since the "Shenandoah" is a purely military ship their enthusiasm is well placed. Speaking from a military standpoint, there is no question that the possession by the United States of the only natural source of supply of helium of any magnitude in the whole world, places us in a very strong position in naval and military warfare, so far as lighter-than-air ships are concerned. Helium is an inert gas, that is to say it can neither be set on fire nor exploded. The "Shenandoah" can never be wiped out of existence with the suddenness that marked the loss of the "R-38," "Dixmude," or "Roma." No one, of course, claims that the "Shenandoah" is immune from fire. Any aircraft, whether heavier than air or lighter than air, that is driven by gasoline engines is exposed to grave fire risk, and the "Shenandoah" herself is not exempt; but her officers claim that any fire that started would be comparatively small at the outset and with reasonable watchfulness would be detected and extinguished before it spread. So great is the military advantage conferred by our possession of the only extensive natural sources of helium, that it is considered by some of our aeronautical officers that helium should be pronounced a military asset and restricted, so far as the United States is concerned, strictly to naval and military use. They claim that the sources of supply and the extraction of the gas should be placed exclusively in the hands of the Government, and that its exportation to foreign countries should be prohibited. We think that the point is well made, particularly as the present high cost of helium renders it prohibitive for passenger or freight airship service. Such prohibition would work no hardship to commercial companies either in the United States or abroad. Its value is of a strictly military character, and the foreign powers would recognize our reservation as an obvious and perfectly just precaution.

At present, with hydrogen costing a few dollars per thousand and helium from 40 to 50 dollars, commercial airship companies are restricted of necessity to the cheaper gas. The lift per 1000 cubic feet under standard atmospheric conditions is, for hydrogen 71.1 pounds, and for helium 65.8 pounds, a difference of 5.9 pounds in favor of hydrogen. The gross lift of the "Shenandoah" with helium is 126,800 pounds; fixed weight, 77,450 pounds; net lift, 49,350 pounds. The gross lift with hydrogen is 137,300 pounds and the net lift 59,850 pounds—a gain with hydrogen of 10,500 pounds. With gasoline at six pounds per gallon, and a consumption of .48 pounds per horsepower hour, this would mean an increased radius of 945 miles, at cruising speed of 45 miles per hour.

Helium is now cleaned through the extraction of the foreign gases, by refrigeration through the use of liquid air. The foreign gases have a higher temperature of liquefaction than helium, and as this liquefaction point is reached they are successively separated out, leaving the helium in a state of purity.



Left: Driving the retreading compound into the rubber with a gasoline torch. *Left center:* Placing the tire in mold, in preparation for fusing. *Right center:* Interior view of the vulcanizer, with three tires undergoing treatment. *Right:* Cross section of a tire, showing the contrast when black rubber was fused with the white left on the tire, and demonstrating the saving of rubber. The fusion is perfect and permanent.

Details of the process for retreading tires so that they stay retreaded

Is Tire Retreading a Failure?

MILLIONS of tires are annually thrown away simply because their treads have worn through, while the carcasses are almost as good as new. If there were a basis for faith in the common vulcanizing method of retreading, this would not be the case. In general, vulcanizing has not made good.

In attempting to join a piece of new rubber to the old rubber of the worn tire, there is trouble. It will not stick. Therefore, it is customary to strip the worn tire right down to the cord or fabric carcass, throwing away what remains of the old tread, the breaker and the cushion. The carcass is then roughened with a rasp so that the new rubber will make a bond with the tiny threads that are thus exposed. This bond, as a matter of fact, is seldom strong enough to last long. A way to join rubber to rubber—new rubber to old—so that they will not only stick together, but so that they actually fuse together just as two pieces of electric welded metal fuse together, has long been needed.

Such a process has now made its appearance. It practically scraps most of the methods used by the tire vulcanizer and substitutes simpler ones in their place. The usual steam vulcanizing is a very critical operation—one involving close attention, in order to see that the exact degree of heat and duration heat is secured. The heat is afforded by means of steam under heads varying with the temperature desired, a pressure of 50 pounds per square inch corresponding to approximately 300 degrees Fahrenheit. The new process dispenses with steam and uses dry heat, such as that from a gas burner.

In retreading a tire by this process a worn shoe is first gone over thoroughly both inside and out for signs of carcass failure. It is worse than useless to attempt to build up what is expected to become practically a new tire on a carcass that is weak or cut. If strong and solid, a coating of a liquid compound is applied with a brush, to the exterior, and is driven into the rubber by means of a common gasoline torch. This compound under the influence of heat penetrates very rapidly and has the effect of desulfurizing the rubber to a depth of about one-eighth of an inch. It is the presence of the large contents of sulfur in the rubber which has heretofore made it impractical to join old rubber to new.

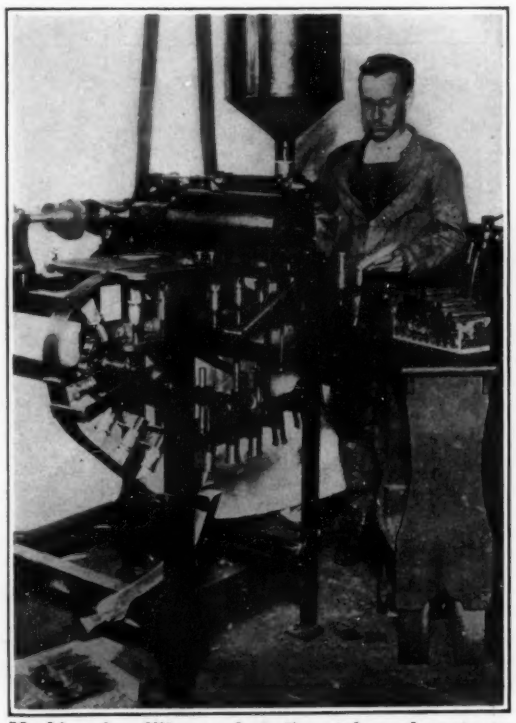
This compound temporarily holds the sulfur in suspension without actually removing it from its position. As vulcanized rubber contains up to 25 per cent of sulfur (which, by the way, is not an adulteration but is absolutely necessary to the making of rubber that is to be put to practical use), the minute it is dissolved the rubber becomes a soft, tacky mass, similar to raw rubber.

Next, a strip of raw or uncured rubber known by the trade as a "camelback" is cut to the exact length necessary to encircle the tire completely and is carefully applied. This adheres to the desulfurized rubber tightly enough to stay in position until the later curing process has fused it with the tire. The job is now ready to be placed in a spreader-stand for the purpose of spreading open the entire tire to permit the insertion of a long, snake-like sandbag. This is used as a filler and for the later application of mechanical pressure within the tire.

The tire is placed in a mold, its upper half is clamped in place, and pressure is exerted on the sandbag radially from the inside by means of a number of evenly distributed screws. The dry sand distributes this pressure evenly over the whole inner surface of the tire.

The tire, or tires as the case may be, is placed in a steamless vulcanizer and dry heat, not the steam customarily used in the vulcanizing process, is applied to it for a duration of two hours. Here is one of the great advantages of the process. In vulcanizing with steam instead of with dry heat it is very difficult to keep the pressure, and therefore the heat, at a uniform degree.

The change that takes place when the heat is applied is interesting. The compound that is used for temporarily desulfurizing the layers of rubber on the surface of the old tire, is evaporated. At the same time the two pieces of rubber are fused together. Actually they become one. If torn apart the tear is no more apt to follow the line of demarcation between the old and new rubber than elsewhere. In fact, that line has really been obliterated. It is as if you poured melted butter on hard butter. The melted butter will remelt some of the other, and on cooling the two will be one. In the case of the tires, the old and new rubber, regardless of the accident of different color, become one. The fusion is, according to the inventor of the process, permanent. The chief advantage of this new process of tire retreading, then, are that it utilizes the old rubber of the tread instead of removing it; it is much simpler than common vulcanizing, dispensing with steam entirely: and it can be performed more cheaply and by less skilled labor. At the time the process which has just been described was witnessed, two new hands, both aliens, were being broken in. Although these men had been at work but one day they had already picked up enough familiarity with the simple process to need no supervision. Its outstanding aspect is its simplicity. Lastly it makes a joint that really holds.



Machine for filling and sealing tubes of paste or cream

National Trade Mark Law in China

A NATIONAL trade mark registration law has been enacted in China, provisions of which make it necessary to register all trade marks under the new regulations to maintain the rights of the proprietors. Property rights in a trade mark in China are now determined by the date of registration and not by the date when the trade mark was first used in that country; although in some cases, it may be possible to claim an earlier date of priority by filing evidence of consulate and customs registrations. The term of registration is twenty years and may be renewed.

On the filing of an application the papers will be published for a period of six months during which time opposition may be lodged. An opposed application will be decided by three examiners from whose decision an appeal may be taken to the minister of agriculture and commerce and from the minister's decision an appeal may be taken to the Chinese courts. Inasmuch as citizens of the United States still have territorial rights in China, a citizen of the United States will probably be entitled to have a representative seat with the three examiners in deciding the case and the same will probably be true at a hearing of an appeal before the minister of agriculture and commerce and before the courts.

While it is not absolutely necessary to use the trade mark in China before the trade mark is registered in that country, it is necessary to use the trade mark within one year of the registration and this use must not be discontinued for two years.

On the infringement of a registered trade mark, the infringer may be required to pay a fine not exceeding five hundred dollars, or, he may be imprisoned for a period not exceeding one year. The goods on which the infringing trade mark has been used may be confiscated. Civil provisions of the law permit the injured party to take the infringing goods which have been seized at a valuation to be determined by the court with a possibility of a deficient judgment.

Packing Paste in Tubes

IT IS simple enough to squeeze the shaving cream and the tooth paste out of their tubes in the morning; but did you ever stop to wonder how they got in the tube, originally? If the remark leads you to question how this is done, the answer will be found in the annexed picture. The empty tubes are placed in sockets and run on an endless band. They first pass under the nozzle of the vat containing the substance with which they are to be filled. This appears, in the picture, immediately in front of the operator, descending from above. After the tubes are filled from this, they pass further along the machine to be mechanically sealed. As the tubes pass on around, and assume a position in which they would be likely to fall out of their holders, they come in contact with a broad metal band, seen at the left of the apparatus, which holds them in—until they reach the mouth of the chute. Then the band terminates, and the finished tubes pass out into the box, ready for packing.

Airplane camera without cover, showing the film spools which handle a roll film 75 feet long. The camera is operated automatically to take pictures at any predetermined time

Crop Reporting by Airplane

More Accurate and More Timely Crop Statistics by Means of the Aerial Camera and the Planimeter

By O. M. Kile
Agricultural Economist

THE airplane is about to get a new job. It seems to be the much-needed assistant Uncle Sam has been looking for to help make crop estimates quickly and accurately.

Does this seem preposterous? Experiments already conducted indicate that this is not the fanciful, fantastic idea that it might at first appear.

When an airplane equipped with a camera, flies from three to five thousand feet high over a strip of country, the photograph secured reveals a strip a mile wide across an entire State or series of States if desired. Suppose such a photograph were taken this year, using a railroad or a highway as a guide in order to keep the line of flight identical on successive trips. Then suppose next year a similar photograph be taken on a similar flight, and that photograph be used for comparison. It is evident that this would make a basis for estimating variations in acreages devoted to any particular crop. It would probably be more accurate than any estimate that could be secured if the personal opinions of local reporters had to be depended upon as at present.

If such a strip were taken first lengthwise and then crosswise in any particular State, there is no question but that it would give a fair idea of crop acreage and crop condition in that particular State.

But, you ask, how can the photographs show the acreage? This is one of the fine points which the Department of Agriculture has worked out very satisfactorily.

Glance at the photograph shown on this page. You will notice that it is a very simple matter to determine the outlines of each field. It would be still easier if the photograph were enlarged to several times its present size. Fortunately, there is a most remarkable instrument known as the planimeter, designed for the purpose of computing quickly and accurately the area of irregularly shaped tracts of land as shown on survey maps. A photograph of this instrument appears on the facing page. By setting the dial of the planimeter at zero and running the pointer around the border of each field, the actual number of square inches in the plot is indicated in tenths and hundredths. It is only necessary to know the scale to which the plate is drawn, to read the planimeter in terms of acres.

The reader of a technical turn of mind will immediately ask how the scale can be known in a photograph. Airplanes are equipped with instruments for measuring the altitude and no difficulty is found in maintaining a flight at a given altitude. By a simple and well-known formula the area of a photograph may be calculated when the size of the photograph, the focal length of the camera, and the altitude of the flight are known. For instance, suppose an 8 x 10 photograph were taken at an altitude of five hundred feet with a camera having a focal length of twelve inches. By applying the formula this would show that the area represented by the photograph is nearly one square mile or that one square inch of the photograph represents nearly four acres.

Mr. B. R. Coad, the intrepid aviator who has been conducting boll-weevil dusting experiments in Alabama for the United States Department of Agriculture, where he has sprayed clouds of arsenate of lead from an airplane over great acreages and with remarkable success, is the man who has been doing the experimental work in the recent tests of the feasibility of the airplane in crop reporting work. Charles E. Gage, of the Department of Agriculture, is the official in charge, and has made many flights with Mr. Coad. When asked concerning his opinion as to the practicability of this system, Mr. Gage said:

"An airplane can travel at a speed of a hundred miles an hour without trying. It can be supplied with a mechanically-operated camera and large rolls of film so as to obtain a continuous photographic record of the strip of country over which the flight is made. These photographs can be computed to show with reasonable accuracy the number of acres of each crop and the ratio of one crop to another. Such a record made for the entire width of a State would be a cross-sectional record. Three or four such records across the State at suitable intervals would give an index to acreage ratios capable of being interpreted with great accuracy in terms of total acres planted.

"The extent to which such a record could be used can be appreciated best if one has learned to understand the stability of averages. It is because of the stability of averages that accurate data as to a comparatively limited number of farms, will give a true indication of what is taking place on all farms. The same principle is employed by the cotton buyer who takes a few scattered samples from a bale of cotton to determine the grade of the bale, and by the tobacco buyer in sampling a hogshead of tobacco.

"In making pictorial records of field crops the altitude from which they are to be made is the first point to be settled. The real question is, what is the greatest height from which the different crops can be recognized in the photograph. This is of importance, because the greater the altitude the greater the expanse of country taken by a single exposure. The picture may show a strip of country anywhere from less than a mile to three or four miles wide, depending upon the altitude, the focal length of the lens, and the size of the picture. In order to throw light upon this point, therefore, it was necessary to photograph a selected strip of country from various elevations, from 500 feet to 20,000.

"To distinguish crops from each other will require some experience. This will not be as difficult as one might think at first. A given crop is found to possess certain signs and tokens, a certain characteristic mass effect, by which the experienced eye can readily detect it."

Another method of using the photographs, which is more rapid and will give excellent results in some sections, consists of merely counting the fields in different crops. In some parts of the country, particularly in some southern States, the size and shape of fields are governed largely by natural geographic features. It has been found that counts of large numbers of fields just as they occur along highways, for instance, will show ratios agreeing very closely with the ratios in actual acreage, due to the fact that they tend to average out in size. The computation of the actual number of acres would be the more accurate of the two methods; the computation of ratios based on numbers of fields would be the more expeditious.

The chief problem presented to the crop estimating service is that of arriving at a sound estimate of acreage early in the season. Here is where the Department of Agriculture has had to depend on many thousands of reporters scattered throughout the country. Naturally, each man is influenced more or less by conditions on his own farm. He knows more about his own crop than he does about crops in the rest of the township, and in some instances his estimates may be far from correct. It is out of the question to make an actual census of acreages quickly enough to be of any use during the current season. And here is where the airplane, with its quick and accurate check-up, gives the best opportunity to make comparisons with conditions in the same strip the previous year. This comparison may show a 5 per cent gain or possibly a 10 per cent decrease in corn or cotton acreage. By

Typical crop-reporting photograph taken at an altitude of 3000 feet. Not only can the acreage of the different fields be accurately determined, but the nature of the crops can be determined with due practice by the characteristic appearance

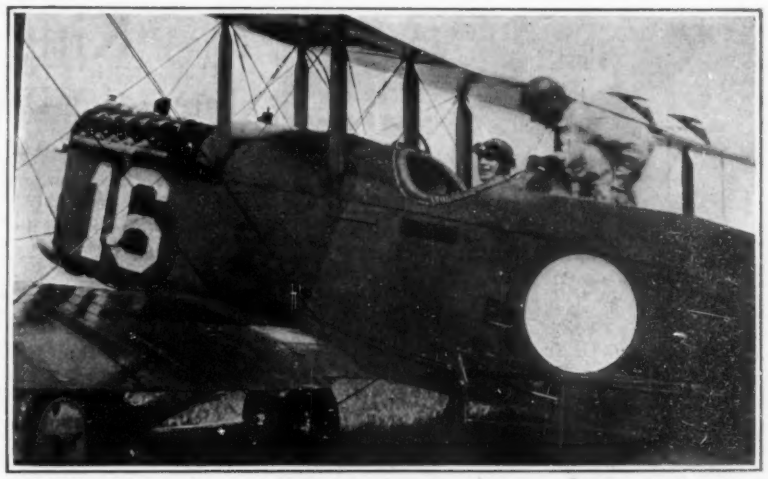
applying this percentage to the entire State, it seems that remarkably close estimates can be made.

Naturally the higher the elevation at which the flight is made, the wider the strip of territory included in the photograph. But this advantage is gained at the disadvantage of faintness in detail. Experimental work carried on by the United States Bureau of Standards has, however, developed a method of bringing out these faint boundary lines so as to be much more distinct. These experiments were started late in the recent war and the methods have since been greatly improved.

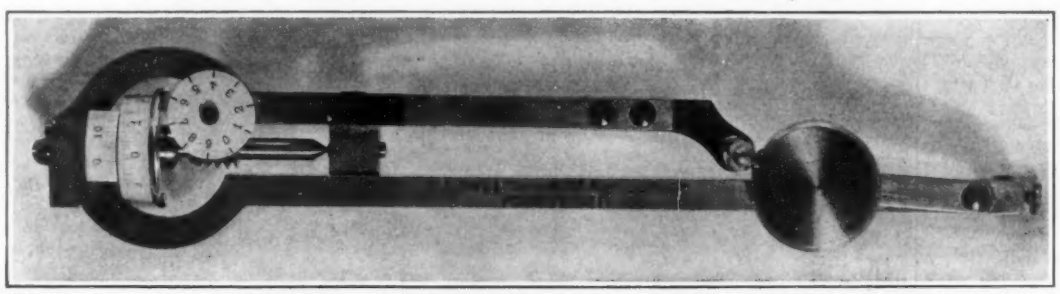
Crop reporting by airplane is in its infancy, of course, but there seems to be every reason to expect important developments in this science. The experimental work done to date has had to be carried out with whatever apparatus was available. Airplanes and cameras loaned by the War Department have been used. It is probable that improved apparatus can be designed for taking the photographs, and improved methods worked out for identifying the different crops, noting their condition as indicative of probable yield, and in measuring areas. The first practical use of this system will probably be as a check on the figures secured by the present methods.

One of the points to which the Office of Crop Estimates is now turning its attention is that of the degree of accuracy with which it is possible to determine the different crops as recorded by the camera. When flying at 7000 feet the camera used covers an area of 4475 feet by 5625 feet, practically a square mile. Those who have spent a little time in studying the photographs find it easy to point out which of the fields were planted to cotton, corn and hay, but it is very much easier to do this from photographs taken at 4000 feet elevation where the camera covers an area of but 2500 feet by 3215 feet. In the photographs the cotton plant presents a characteristic rounded shape which is quite different from that of corn.

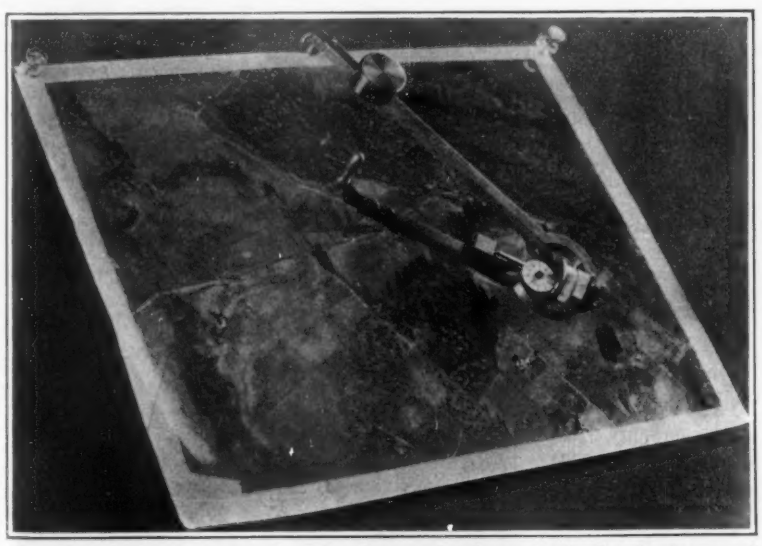
There are still many points to be determined regarding how this aerial crop-reporting plan would work in other parts of the country where the field crops are mostly small grains. Possibly the picture would have to be taken at a lower elevation. Then, there is the question of how rapidly the pictures can be interpreted to be of practical value. At Tallulah the pictures were taken one day, developed and printed during the night and were ready the next day for study. The question of cost is being studied by Mr. Gage and his associates. The answer to these various questions will probably be worked out during the next few crop seasons providing Congress makes available the wherewithal for the work. It may become the common thing before long for the Department of Agriculture to keep a flock of airplanes to send forth from time to time over carefully predetermined routes and bring back photographic evidence of the season's crop prospects. Thus we have another unexpected application of the airplane in the pursuit of peace.



DeHaviland type plane ready to take the air for a crop survey flight. The aerial camera takes the pictures through an opening in the fuselage floor



The planimeter, designed for the purpose of computing quickly and accurately the area of irregularly shaped tracts of land as shown on survey maps and aerial views



How the planimeter is used. The sharp point beneath the handle is moved around the boundaries of the field, while the other leg of the compass-like instrument remains fixed. The dial records the area in square inches. The territory shown in this photograph is just one mile wide

Australian Power Projects

THIS journal in a recent number had an excellent article dealing with the Burringjuck irrigation scheme (N. S. W.) and closing with the remark that Australian enterprises were not brought before Americans as much as they might be. Hence it is a pleasure to give a few particulars of the great electric scheme now being pushed ahead in Victoria. Gippsland, the eastern part of this southernmost state, possesses almost unlimited brown coal resources, the Mines Department's official tests revealing three areas each of thirty square miles with great thicknesses of coal and very little overburden. One bore put down 1010 feet at Morwell revealed 780 feet thickness of brown coal, but as a general rule the seams are not thicker than 150 to 180 feet and have an overburden of 25 to 30 feet. The fact that a 150-foot seam means 250,000 tons to the acre shows how literally the word "unlimited" can be used. Of the three Gippsland areas, the one at Morwell (nearest to Melbourne and most easily worked) is estimated to contain 5000 million tons of brown coal; another field a little further out has 5600 million tons, while several smaller fields bring the state's total up to 11,000 million tons, that is 7000 tons of brown coal accessible for every man, woman and child in the state. With some realization of the uses to which these fields might be put, the state government in 1918 passed an "Electricity Commissioners' Act" authorizing a commission to inquire into and report on all electrical undertakings then existent, secure cooperation among them, promote the use of electricity for any and all purposes, investigate possible sources of electrical energy from coal or water-power and, in general, to operate any undertakings they see fit to and have general control over electrical enterprise throughout the state.

The commission has already spread its activities over a great part of the state. In the Morwell district (85 miles east of Melbourne) it has taken over and is working *one* square mile of coal country, estimated to contain enough brown coal to satisfy Victoria's requirements for 150 years to come. This is being worked at open cuts and a great power station with an initial capacity of 50,000 kilowatts erected. Power is to be transmitted at a voltage of 6600 along a 90-mile line of 75-foot steel towers to Spotswood, a suburb of Melbourne, which is to be the chief distributing center.

In 1910, Victorian factories used electrical energy to the extent of 9500 horsepower; in 1920 this had grown to 50,000 horsepower and since that date rapid increase has taken place. The electricity commission has definitely in mind the supplying of all important towns between Bairnsdale (170 miles east of Melbourne) and Warrnambool (165 miles west of Melbourne). Although the commission had this in view at the time, the shire council of Colac, a town of 5000 people, 95 miles west of Melbourne, completed in September, 1921, an electric power station of their own, which did good service until it was unfortunately destroyed by fire, November 24, 1922. Then the commission "got busy" and instead of the council re-erecting a £9000 station and having it dismantled when the commission's Morwell scheme was finalized, the latter body undertook to erect post-haste a line from Geelong, 50 miles distant, and get a temporary supply from another organization in that city. The necessary authority was obtained, a supply obtained of enough 45-foot wooden poles for the 50-mile line, with all necessary wiring and equipment; the line and a new power sub-station and transformer station erected and the power finally switched on to Colac on April 13th, 140 days after the fire. The actual construction work of the 50-mile line took place in about half this time and is thought to be a world's record. The line will be later used to supply the western district with power from Morwell. The power is later to be made available to even scattered farms and townships in the vicinity of the direct lines. The whole of Melbourne's suburban railway system, extending twenty miles out in some cases and handled from the central station referred to in the SCIENTIFIC AMERICAN some months back is now electrically operated and power is later to be obtained from the commission.

Fighting Senility

EXPERIMENTS recently made by Dr. Semerád, at the General Hospital, of Prague, and by Professor V. L. Mladejovsky, at Marienbad, Czecho-Slovakia, with a vegetable extract of *Drosera Rotundifolia* and colloidal silicates, have brought out a remarkable alleviating effect on the ailments of old age. While Drosera has long been popularly regarded as a good remedy against arteriosclerosis, Professor Mladejovsky's experiments show blood pressure to be reduced by the action of silicates. Chemical and physiological tests made at a Marienbad chemical laboratory finally resulted in the production of an extract containing all extractive components and which, already after a few days' use, was found to bring decided relief to persons suffering from arteriosclerosis and insomnia. It is contended that this product contains no harmful ingredients.

According to a personal report from Professor Mladejovsky, the effects of the new treatment are surprising, many desperate cases having been cured or greatly relieved. *Angina pectoris*, asthma and other serious symptoms often will disappear already after a couple of days. Apart from these remarkable phenomena, the substance used by Professor Mladejovsky shows many interesting chemical reactions.

The dismantling of the shrine. Mr. Carter and his staff lowering the roof of the shrine

King Tut-Ankh-Amen's Treasure

Interesting Details of the Work of the Archaeologist as Disclosed in the Carter-Mace Book Just Published

Photographs by Mr. Harry Burton of the Metropolitan Museum of Art and Copyrighted by *Times-Wide World*

THE arrival of Mr. Howard Carter in this country for a series of lectures, follows only a few weeks after the publication of the book which he wrote in collaboration with another prominent archaeologist, Mr. A. C. Mace. The title is "The Tomb of Tut-Ankh-Amen," and Doran, of New York, is the happy publisher.

The volume in question is the first authoritative account of the Earl of Carnarvon's famous discovery in The Valley of the Kings. A biographical account of Tut-Ankh-Amen and his queen, a history of The Valley of the Kings, a full record of the discovery of the tomb, and finally, the opening of the sealed door, followed by an account of the treasures that lay behind it—these Mr. Carter describes in terse, interest-holding words. For six full seasons Mr. Carter had excavated, and season after season "drawn a blank." "We had almost made up our minds that we were beaten, and were preparing to leave the Valley; and then, hardly had we set hoe to the ground in our last despairing effort (November 4, 1922), than we made a discovery far exceeding our wildest dreams," writes Mr. Carter in his modest way.

Before going into some detailed aspects of the find, it might be well to correct some erroneous opinions concerning Mr. Carter. He is usually rated as of American, but as a matter of fact he told the ship news reporter that this was his first trip to America. He was employed twenty years ago to make excavations at Thebes, for the late Theodore M. Davis of Boston, which probably accounts for the myth of his birth on our shores. Naturally, he was asked about the supposed curse of the Pharaohs. He said that Tut-Ankh-Amen had inscribed on the inside of his coffin lid: "Let all who love life and hate death wish thousands of geese and bread and beer to my soul."

As to the superstition that Lord Carnarvon's death was a punishment for financing the accursed work of digging up a royal tomb, Mr. Carter said: "I have been finding the royal tombs of ancient Egypt thirty-four years, and my health is still good, isn't it?"

Mr. Carter seemed to be in the best of health and spirits and is ready to resume his thrilling labors when the climate permits and the Egyptian authorities relent. We give the following status of the work, as the book was necessarily written a few months ago. Mr. Carter said: "As the work now stands in the tomb, the lid of the stone sarcophagus has been lifted, and we have exposed the outer coffin of a series within which the King is buried.

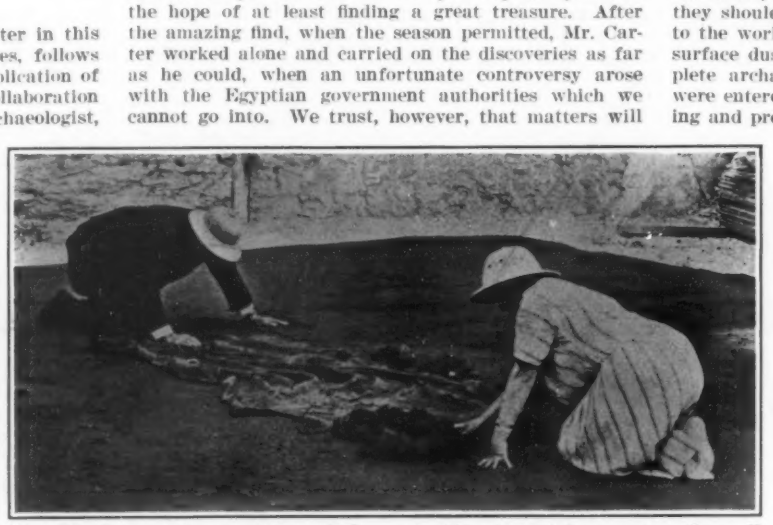
"According to ancient records, we shall find him wrapped in sheets of beaten gold. He is almost canned in gold, you might say.

"I am against disturbing the dead irreverently, yet if it were not for this research work, we should know nothing about ancient Egypt and its wonderful civilization.

"I will do all in my power to see that the King will never be moved from his tomb. If we can examine by X-rays without unrolling him, it will be done. I am against exposing any mummy in a glass case. And as for the royal bodies now resting in the Cairo Museum, I think they should be returned to their tombs."

Now to return to the book from which we have digressed to speak of Mr. Carter. The co-author is Mr. A. C. Mace, Associate Curator of the Egyptian Department of the Metropolitan Museum of Art, who happened to be in Egypt at the time and gave willing aid of great value, for trained archaeologists of such scientific attainments as Mr. Mace are rare. Fortunately, the Museum had another specialist in the field, Mr. Harry Burton, and he took the interesting photographs which illustrate the book.

In the romance of archaeology there is nothing more thrilling than the story of how this great find was made, which we have already told several times. The cables were clogged for weeks with the results of the remarkable find. Unstinted credit must always be given both to Mr. Carter and Lord Carnarvon: Lord Carnarvon poured out his money freely for years in the hope of at least finding a great treasure. After the amazing find, when the season permitted, Mr. Carter worked alone and carried on the discoveries as far as he could, when an unfortunate controversy arose with the Egyptian government authorities which we cannot go into. We trust, however, that matters will be adjusted so that Mr. Carter can spend the third season in completing the work which was begun so auspiciously.



Mrs. Newberry, vice-president of the embroiderer's guild repairing the pall fabric. This is typical of the painstaking restoration work

The first chapters of the book deal with such related matters as "The King and the Queen"; "The Valley and the Tomb"; "The Valley in Modern Times." Then follow chapters on the prefatory work, the finding of the tomb, the preliminary investigation, and then the actual clearing of the antechamber and the opening of the sealed door.

The most interesting chapter to us is perhaps that devoted to "Work in the Laboratory," which gives valuable side lights on the rigors of the work of the archaeologist. The authors say: "This chapter is dedicated to those—and they are many—who think that an excavator spends his time basking in the sun, pleasantly exhilarated by watching other people work for him, and otherwise relieved from boredom by having baskets full of beautiful antiquities brought up from the bowels of the earth from time to time for him to look at. His actual life is very different, and, as there can be but few who know the details of it, it will be worth our while to give a general outline here before going into the question of the laboratory work of the past season. Incidentally, it will help to explain why this careful laboratory work was necessary."

"In the first place, it must be clearly understood that there is never any question of having basketfuls of objects brought to the excavator for him to look at; the first and most important rule in excavating is that the archaeologist must remove every antiquity from the ground with his own hands. So much depends upon it. Quite apart from the question of possible damage that might be caused by clumsy fingers, it is very essential that you see the object *in situ*, to gain any evidence that you can from the position in which it lies, and the relationship it bears to objects near it."

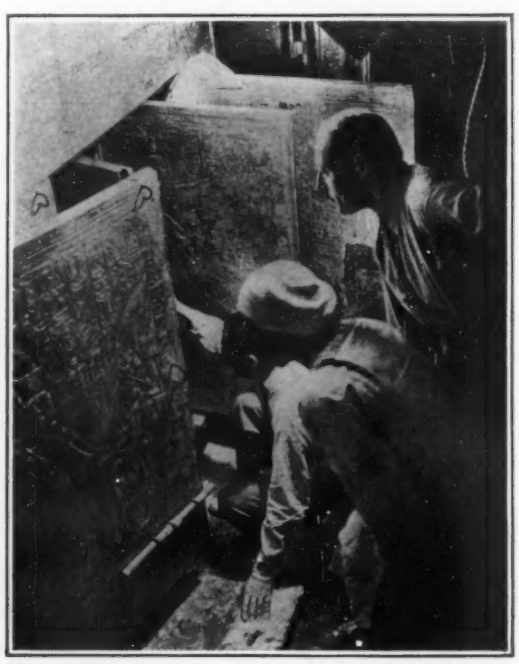
"One other matter before we pass on. By noting the exact position of an object, or group of objects, you cannot infrequently secure evidence that will enable you to make a find of similar objects elsewhere. Foundation deposits are a case in point. In every construction the arrangement of the deposits followed a regular system, and, having found one, it is a simple matter to put your finger upon the others. An excavator, then, must see every object in position, must make careful notes before it is moved, and, if necessary, must apply preservative treatment on the spot. Obviously, under these conditions it is all important for you to keep in close touch with your excavations."

After describing the preliminary work and observations, the authors take us to the laboratory which was in the tomb of Seti I. They continue: "The tomb was long and narrow, so that only the first bay could be used for practical work, the inner darker part being serviceable merely as storage space. As the objects were brought in they were deposited, still in their stretchers, in the middle section, and covered up until they should be wanted. Each in turn was brought up to the working bay for examination. There, after the surface dust had been cleared off, measurements, complete archaeological notes, and copies of inscriptions were entered on the filing cards. The necessary mending and preservative treatment followed, after which it was taken just outside the entrance for scale photographs to be made. Finally, having passed through all these stages, the object was stored away in the innermost recesses of the tomb to await the final packing.

"In the majority of cases no attempt at final treatment was made," states the book. "It was manifestly impossible, for months, probably years, of reconstructive work are necessary if full use is to be made of the material. All we could do here was to apply preliminary treatment, sufficient in any event to enable the object to support a journey in safety. Final restorations must be made in the museum, and they will need a far more fully equipped laboratory and a much larger staff of skilled helpers than we could ever hope to achieve in The Valley."

"As the season advanced, and the laboratory grew more and more crowded, it became increasingly difficult to keep track of the work, and it was only by close attention to detail, and strict adherence to a very definite order of procedure, that we managed to keep clear of complications. As each

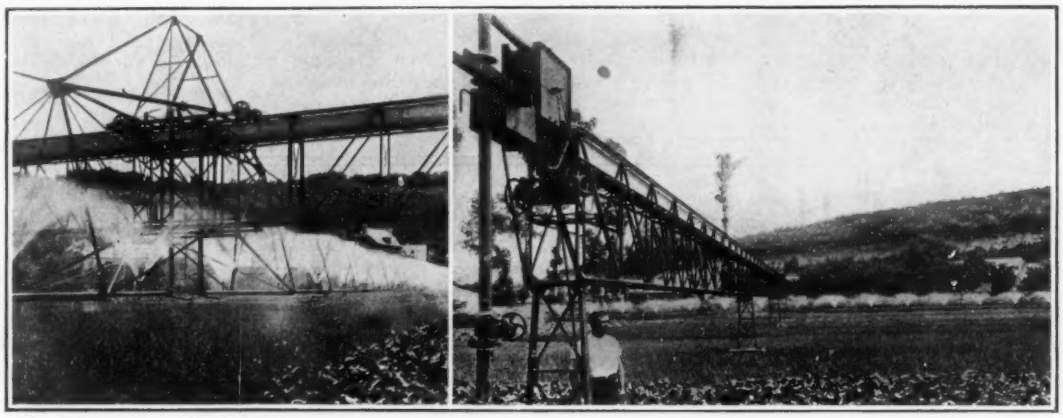
(*Continued on page 70*)



The actual opening of the doors of the fourth shrine revealing the stone sarcophagus. Mr. Carter is kneeling

A Novel Irrigation Sprayer

AMONG the fairly familiar roadside scenes in America is the overhead spraying plant utilized by the large truck farmers. For cheap and effective watering of a large area, there is perhaps nothing to equal this; but a French inventor is now on the market with a somewhat different outfit for use on relatively small fields. This consists of a spraying machine running on an overhead track, as illustrated. It will be observed, in our left-hand view, that the understructure of the sprayer extends out, perpendicularly to the line of the track; and, of course, this extension is without any particular limit save that imposed by the carrying capacity of the bridge itself. Specific information is not ours on a sufficient basis to permit a detailed description of the outfit; but we gather from the picture that the track on which the sprayer runs is in the form of a flume; and that the water is delivered to this flume from the standpipe at the end, (see the right-hand view) and taken up for spraying by the machine as it passes. The advantages of having, at all points, the full head of the full flume, are doubtless responsible for this feature of the design. No statement is made regarding the motive power of the spraying unit; the photographer is apparently under the impression that the adjective "automatic" covers all the ground there is to cover here.

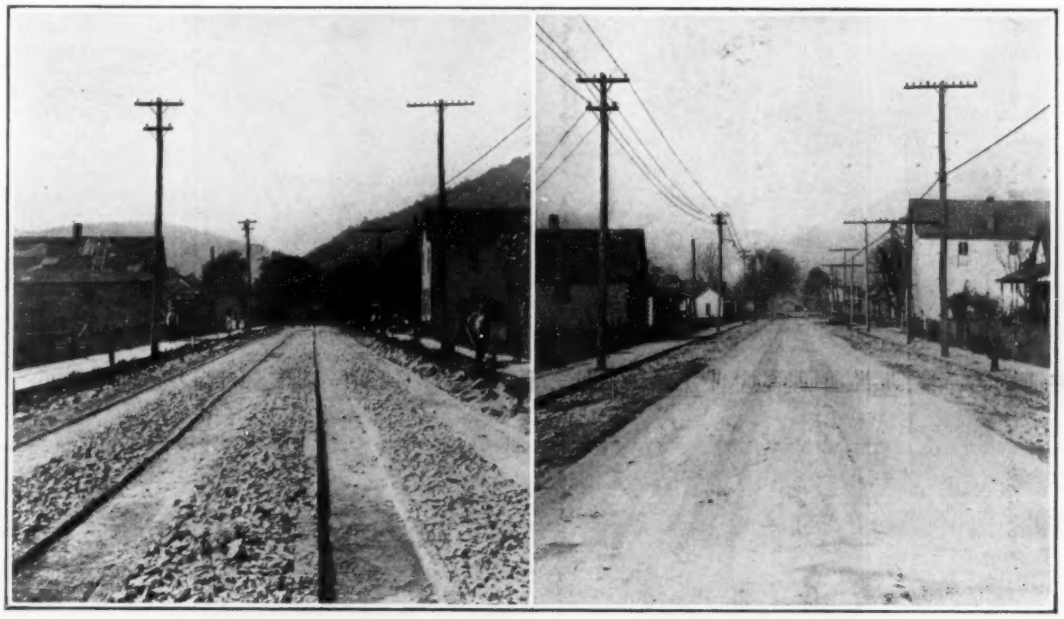


Left: The sprayer at work, showing the way it extends across the field from the bridge. *Right:* The wheels and rails that carry the sprayer across the fields

Irrigating a field by spraying from an overhead traveler

The Railroad Track Highway

THE State of Kentucky has been experimenting with a new type of pavement for highways. It was recognized that whereas our macadam roads, concrete roads and other kinds of roads are of practically the same construction from side to side, traffic, for the most part, follows a "rut"—it finds a path on part of the road and sticks to it, except when passing or turning out. Here you have two salient facts — too much traffic on a pair of one-foot ribbons and almost none on the rest of the pavement. Why, then, build the two parts the same? Why not build the parts which traffic uses only for passing, etc., poorer and use the money thereby saved for building the two tracks or "ruts" much better? This is just what the Department of State Roads and Highways of the Commonwealth of Kentucky has been doing at Pineville, in that State. The "Invisible Track Highway," designed and patented by S. B. Moore, consists, first, of two longitudinal 20-inch concrete tracks, concealed in the finished road, whose purpose is to carry the moving load; second, of a filling of crushed stone choked with five parts of screenings to one part of cement and rolled before setting; and finally, a one-inch covering of compacted rock asphalt on the rail portions and a one-half inch covering of the same material over the remaining parts. The concrete girders under the trackways were designed on the assumption that the sub-grade would carry a wheel load of 4000 pounds on a span of more than eight feet. A 1600-foot section of this road was constructed in the fall of 1923, and if it is successful it will be used to show how old worn macadam roads can be salvaged where a good base still exists.



Left: Constructing the invisible-track highway, the concrete girders and the crushed-rock filling being in place, ready for the asphalt. *Right:* The finished road, showing the four flat wheel-tracks directly over the concrete girders

The new highway now being developed in Kentucky

In various States will be found large mileages of macadam in bad shape. Of no further value as road surface, this is obviously available as foundation for the new surface, and road-building programs in many localities are being shaped to take advantage of this economy. The Kentucky idea affords a means of doing this that is well worth extensive experiment.

Carp in Sewage Purification

INTERESTING experiments are being made at various points in Europe on growing of carp in dilute clarified sewage with results that show enormous possibilities in the production of food material and more complete reduction of contamination in water courses.

One of these experimental installations is located at Wachen, near Strasburg, where a pond of about seven acres is utilized as a feeding ground for carp. The sewage from the city is first roughly filtered to remove suspended matter, fermented in the usual way in septic tanks, and after settling out the sludge (which is used by farmers as a fertilizer) the sewage water is mixed with about one-half or two-thirds of its volume of fresh water and sent through the carp pond before discharging into the river. The dilute sewage, being rich in organic matter, supports an abundant growth of micro-organisms, which in turn support great swarms of entomostracae (small crustaceans) and on these the carp feed and thrive prodigiously. The water leaves the carp pond much reduced in soluble matter and cleaner than under the usual methods of disposal.

From the data obtained it is computed that for every 3000 inhabitants the carp pond should have an area of 2½ acres and that for the present population of the city of Srasburg a total of about 175 acres would suffice.

Data collected from various places where this system is being tried show yields of fish per acre far exceeding the amount of flesh food that could be produced on an equal area of the best and most heavily fertilized farm land, and experiments designed to show the maximum limit of fish production in these ponds have not been completed.

The Victory Over Rust

RUST has been fought for many years, and at last a victory over this merciless destroyer seems about to be proclaimed. The day is not far distant when bridges will need no painting to preserve them, when steel will need no zinc or tin coating to make it more useful, when wire and wire products will always remain bright and shining with an almost everlasting endurance and when many household and other useful small articles will need no polishing or burnishing to remove a tarnish.

The average reader will suspect at once that stainless steel is referred to, but this is not true. Stainless steel has been on the market for a number of years but is limited in its uses because it is difficult to manipulate and form into various shapes. Its principal use thus far has been for cutlery, for surgical instruments and a few such products as that. It has by no means reached a quantity production because of its limited use. It is very difficult to handle, requires careful treatment but when finished is absolutely stainless and a great boon to the average user.

The product which is likely to win the victory over rust is a comparatively new one. It is known as "rustless" or "stainless" iron. Because it is quite similar to stainless steel it has been confused to some extent in the popular mind with this product, but it is essentially different in certain particulars and can hardly be compared. Recent developments in England and in this country have proved beyond a doubt that rustless iron can be made in all kinds of shapes and forms in which ordinary steel today is now made. This applies to structural shapes from which bridges are made, to sheets and plates, to wire and to many other small products in the hardware class. Rustless iron, as contrasted with stainless steel, when properly made, can easily be rolled into the foregoing products whereas stainless steel cannot. Briefly, stainless iron is a low carbon steel which contains the metal chromium to the extent of about 12 to 14 per cent. Chemically, its only difference from stainless steel is the low carbon content.

Rustless iron is capable of taking a very high polish which, under no circumstances, whether atmospheric or liquid, can be rusted or tarnished. An appreciation of this fact is sufficient for one to realize the many wonderful applications that such a material can be put to. If incorporated in bridges in the unpolished condition, these would need no painting to preserve them. If incorporated in wire, wire fences and similar products would last many, many years. If made into sheets, they would easily displace the galvanized or zinc coated sheets of today and endure many times longer. It is possible that in the polished condition thin sheets could be made which would ultimately replace tinplate for canning purposes.

Already some of these things have been accomplished on a small scale. In England various forms of hardware, such as hooks, electric fans, frames for pictures and other material, framework for grates and many other similar products have been made and are in use. In this country plans are being developed to produce rustless iron on a large scale in the form of sheets from which the roofs and sides of passenger and other cars can be made which will practically last for years. Other applications of this "wonder alloy" are only waiting for the product to be made on a large scale.

More Heat From the Pound of Coal

Adapting the Carbureter and Bunsen Burner Principles of Air Control to the Furnace

By Walter S. Timmis

Past President American Society of Heating and Ventilating Engineers

FOR good combustion it is absolutely necessary to admit air both under and over the fire bed, in the proper quantities at both places, and to diffuse properly the air admitted over the fire bed. It is common knowledge among heating plant operators that opening the slide or wheel damper on the feed door of their heating plants serves to check the fire effectively. In large plants where operating conditions are carefully watched, it has been noted that the admission of air around fire doors or through leaks in boiler setting causes a decrease in efficiency.

One can reasonably assume that these general observations may have had much to do in retarding the dawning of an enlightened mind on this vitally important subject of air admission over the fire; but having had the truth revealed on many obscure problems in this field of combustion, it is of further interest to note what practical application of these truths has been made in rendering them available to the public.

To present briefly a summary of the more striking truths which have been uncovered, the findings of the United States Bureau of Mines may well be quoted. First, in answer to the general belief regarding the admission of air over the fuel bed, the truth is found to be quite contrary to this belief. "Of the air necessary for complete combustion of the fuel," says the Bureau of Mines, "only about one-half can be supplied through the grate; the other half must be supplied above the fuel bed." [Tech. paper 139, page 7.]

Feed Door Slides Inadequate for the Proper Admission of the Air

"Intimate mixing of the combustible matter with the air does not take place in most hand-fired furnaces, and this lack is perhaps the chief cause of smoky chimneys. In the most common furnace design, where the additional air is admitted through the openings in the fire doors, no mixing occurs except by the natural diffusion of the gases. As the air and the combustible gas carrying the particles of carbon in suspension tend to flow in separate streams, combustion takes place only where the two streams are in contact." [Tech. paper 80, page 55.]

Maintenance of a thin fuel bed is sometimes advocated as a method for securing the correct proportion of air over the fire—and the following quotation demonstrates this to be a misconception: "If the fire is level, very little free oxygen passes through the fuel bed, although the latter may be only four inches thick. With a thicker fuel bed the chances of free oxygen getting through the fuel are still less. Therefore, air must be admitted over the fuel bed in quantities sufficient to burn the combustible gases." [Tech. paper 80, page 55.] "The fuel bed, then, acts as a gas producer and its object seems to be to gasify the solid fuel. A bed just thick enough to produce a maximum of CO_2 would be too thin to be practicable." [Tech. paper 139, page 33.]

"All rates of combustion show that in the upper layers of the fuel bed there is 20 per cent to 32 per cent of combustible gases with no free oxygen to burn it; that is the free oxygen is all used up before the air reaches the top of the fuel bed, no matter how fast the air is blown through." [Tech. paper 137, page 51.]

How Air Should Be Admitted

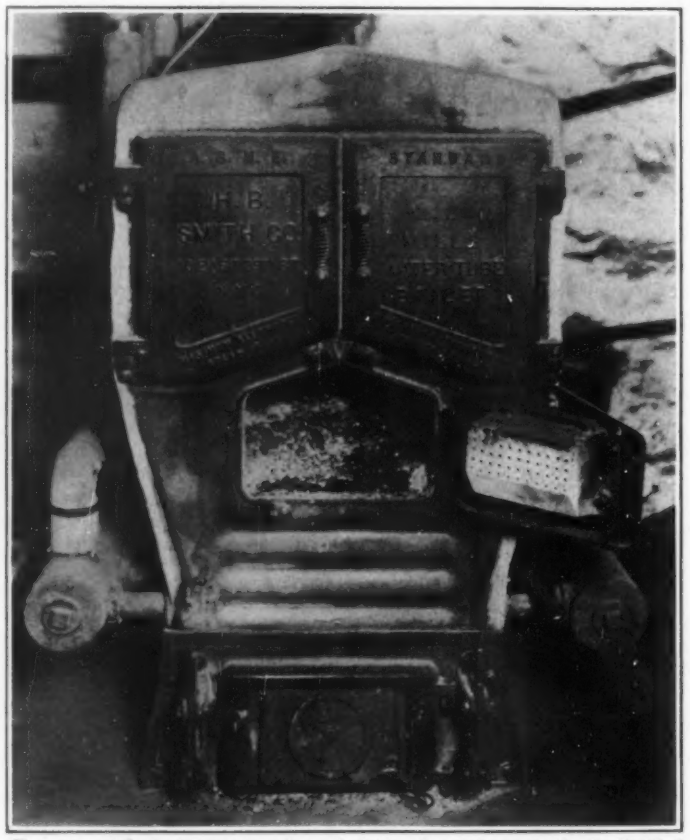
Thus it will be noted that though approximately 50 per cent of the total amount of air used in the boiler furnace should be admitted over the fire, the Bureau of Mines points out that it should not be admitted through feed door slides, through leaks, or through a thin fuel bed and that it cannot be blown through the fuel bed, and they specifically point out that: "The ideal way to supply additional air over the fuel bed is to introduce it as close to the fuel bed and in as large a number of small streams as possible. The nearer the air is introduced to the surface of the fuel bed, the more combustion space is utilized for mixing air with the combustible gases and for burning the mixture." [Tech. paper 137, page 55.]

Controlled Air Admission Not a New Principle

This necessity for secondary air mixture over the fuel bed can readily be understood, when devices in other fields which have had this problem to contend with, of which there are a great many, are considered.

WE know of no more effective coal-saver than a thorough understanding of what takes place in a furnace during combustion of the fuel. So we requested Mr. Walter S. Timmis, Past President, American Society of Heating and Ventilating Engineers, to write the accompanying article. The facts here given, based as they are so largely upon the experimental work of the Bureau of Mines, will prove of vital interest to all coal users and particularly, in view of the high price of coal, to the householder.—THE EDITOR.

Consider the carbureter—how far would the perfection of the automobile engine have advanced, were it not for the fact that carburetion kept pace and developed a delicate instrument which adjusts to the most accurate degree the amount of air admitted to the gasoline—the fuel. Another case in point is the Welsbach mantle, in which the air adjustment must be accurately made, or the mantle will either "blow" or smoke.



Furnace with device in door for admitting heated air, in finely-divided streams, for burning the gases given off by the fire bed

Thus this necessity for accurate air mixture in the carbureter and in the Welsbach mantle is recognized. Now remember that all that is done when air is admitted under the grate in a boiler furnace is to generate a gas in the combustion chamber above. If air is necessary to burn gasoline in the case of the carbureter; if air is necessary to burn gas in the Welsbach mantle, it can readily be seen why air is just as vitally necessary over the fuel bed to burn the gas generated in the combustion chamber in heating plants. It can also readily be appreciated that the quantity of air needed is going to be in direct proportion to the amount of gas generated, and, in turn, that the amount of gas generated is going to be in direct proportion to the amount of air drawn through the fuel bed.

In the Heating Plant

The gas is drawn off the fuel bed subject to a resistance offered by drawing air through the fuel bed itself, and in admitting air to this gas it should likewise be subjected to resistance, if balance is to be maintained and controlled air admission and perfect combustion are to result.

Quoting again the Bureau of Mines: "Obviously, mixing is an important factor in combustion. Merely an excess of air in the furnace is not enough; the air must be supplied as near to the furnace of the fuel bed as practicable and be thoroughly mixed with the combustible matter, in order that the combustion may be completed in a short time and a small combustion space made effective." [Bulletin 135, page 131.]

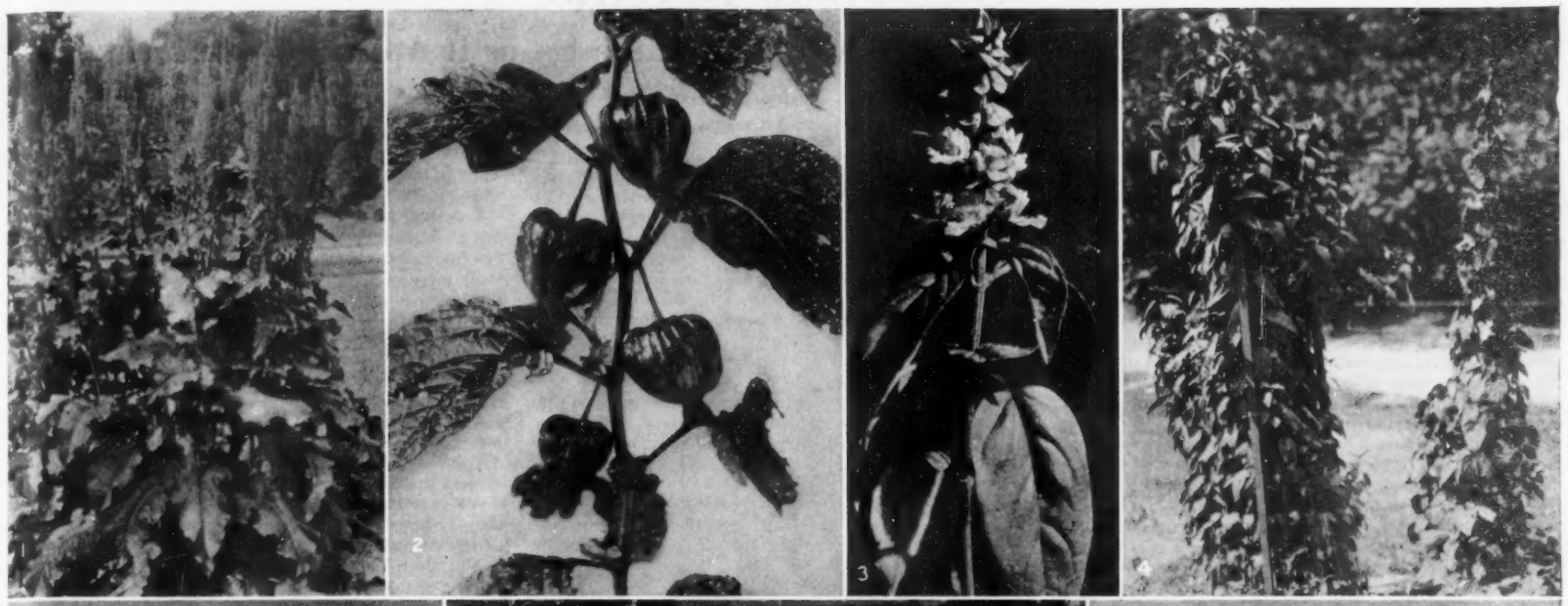
A chemical action can take place only when the reacting substances are brought into contact to form a uniform mixture. If this is not done the velocity of combustion will be limited to the rate of mixing; which leads to incomplete combustion. If the secondary air is added in comparatively large streams, the gases and air tend to remain stratified, and do not form a uniform mixture; but when the air is added in a large number of small streams, the surface of contact is large and the combustion is rapid, approaching the velocity of combustion of a uniform mixture.

Balanced Air Flow Above and Below Fire Bed

Balanced air admission was above mentioned as one of the essential features of any means developed for admitting this so essential secondary air supply over the fuel bed, and a device has been developed which correctly applies this fundamental principle, along with the other essential features of admitting the air close to the surface of the fuel bed and in a large number of fine streams. The resistance of the flow of air through the apparatus itself is made to equal the resistance offered by the fuel bed, thus producing a balanced condition above and below and through the fuel bed—a fundamental requirement for correct and economical combustion which is too often ignored in regular furnace and boiler design.

Our illustration shows a system developed by Mr. Herbert Brunner for each individually different case, which provides means for supplying the necessary diffused and heated air (oxygen) over the fuel to properly complete, in the second stage, the combustion begun in the fuel bed by distillation of gas. The device is of cast-iron cellular structure—the air is controlled and is heated, on passing through this structure, and is then discharged through a large number of small streams over the fuel bed.

In a recent test, a furnace was first operated with an open slide in the feed door. This was then removed and a door of the kind shown in the illustration substituted. In both cases the draft pressures ranged from 0 to .09 inches of water. The amount of air passing over the furnace in cubic feet per minute was recorded by an anemometer. At a draft pressure of .03 inches the open slide passed 320 cubic feet per minute and the controlled admission 30 cubic feet. At a draft pressure of .06 the figures were respectively 420 and 75 cubic feet; and at a draft pressure of .09, the figures were open slide, 525 cubic feet, and for controlled feed, 110 cubic feet per minute. It is evident that the air admitted, through the slide, bears no proportionate relation to the draft pressure or to the quantity of gas being generated in the combustion chamber.



THE sorrel, *Rumex acetosa*, shown in view 1, is well adapted for group planting, and serves the same purpose on the table as the spinach. It requires a loose fertile soil, in which it will develop a tasty foliage and stately flowers.

Physalis franchetti, of the second photograph, is one species of a group whose flowers are not remarkable, but whose fruit, formed after the flowering period, is very striking indeed. These berries are edible, the large subtropical species leading in flavor; but the fruit of all varieties is available for marmalade and conserves.

Ocymum basilicum, illustrated under Figure 3, is a medicinal herb, with charming and delicately perfumed flowers. It is also used for spicing soups, but must be added sparingly for this purpose.

The sweet potato, *Ipomea batatas*, of our fourth picture, is a rapid climber, requiring for its successful cultivation warm nights and plenty of sunshine. It will grow in sandy soil containing a little loam, but a calcareous earth suits it better. The picture shows well its ornamental qualities, which are rather striking, while its useful ones must be familiar to every reader.

A strong contrast is *Hibiscus esculentus* (5), more familiarly known as okra. This plant develops a large and showy flower of exceptional beauty. The soil must be kept loose for this, and frost must be avoided.

Doubtless the most familiar of all the plants we show on this page is the rhubarb, or *Rheum rhaponticum*, of Figure 6. Why this stately and decorative member of our flora should be exiled to the vegetable garden, just because it happens to be edible, is a puzzle. The plant grows in such profusion that one can well afford to leave a few leaf stalks uncut, to allow their flowers to appear.

More of a stranger is *Martynia proboscidea*, our next subject. The handsome flower illustrated is large, pale red or purplish, with brownish spots on the upper lip. The inside is spotted and the lower lid is provided with golden yellow stripes and thin white lines. These flowers grow in upright racemes. One needs no excuse for including it in a flower garden; it finds a place in the vegetable-flower garden by virtue of the fact that its pods may be converted into a very satisfactory pickle.

The blue flower of the chicory, *Cichorium intybus*, Figure 8, is very attractive, but the plant itself is rather straggly, and in the garden should be trained to overcome this. Chicory is one of the oldest of cultivated plants, and its roots are one of our oldest foods. It will perhaps be news to many readers that the shoots may be used like lettuce. The leafy plant of our ninth photograph rejoices in the name of *Mesembryanthemum cristalinum*. It is used in place of the true spinach wherever the latter will not do well on account of excessive summer heat; in such localities it grows luxuriantly—the more burning the sun, the better. It develops thick fleshy leaves and stalks, and on the ends of its two-foot shoots come dainty white flowers that open in the noon-day heat.

With our last picture we again have something whose presence among the vegetables rather than among the purely ornamental flowers must be explained. Sweet woodruff *(Asperula odorata)* is not merely an attractive though modest flower; it is extensively used as an herb in many parts of Europe, its chief utility being as a flavoring for beverages.

VEGETABLES FOR THE FLOWER GARDEN, COMBINING UTILITY WITH FLORAL BEAUTY

Our Next Psychic

A Preliminary Account of the Case that Now Comes Before Us, as It Appears to the Naked Eye

By J. Malcolm Bird

Secretary to the SCIENTIFIC AMERICAN Committee on Psychic Investigation

THE LADY about whom this story revolves is the wife of a professional man of prominence in the city of their residence. Her brother was regarded as psychic while in this life. After his death, curious things began to happen; which were gradually systematized until they had acquired the form of mediumship by the sister, under the control of the brother. Within the past year this mediumship has turned strongly toward objective phenomena of great distinction. I have attended many of the seances, and receive circumstantial reports of all that are held. There appear but two alternatives: either the lady is one of the strongest objective mediums yet known, or these reports must be dismissed. Their content is such that they cannot be altogether honest error; if not accepted, they require dismissal as actual fabrication, in which event certain of my own observations must also be explained away.

The favorable moral factors of the case it is impossible to exaggerate; I consider them stronger than in any contemporary instance of physical mediumship. The psychic is so much a lady of refinement and culture that to speak of this feature gives one who knows her a lively sense of bad taste. It follows that the mediumship is wholly private, non-professional, and free from the odor of money. Indeed, entertainment of the sitters is done on a scale that makes it a large item of expense. I have been one of a restaurant party of nine, and for weeks at a time there are guests at every dinner. Nor am I the only sitter who is put up for the night.

Dislocation of the family life by all this is acute, and the psychic's role as mother of her twelve-year-old son is seriously hampered, to her keen realization and concern. The mediumship and its attendant philosophy, of course, occupy a large place in the mental life of the household; but these are not people who need to improvise a sphere of mental action, and in my judgment there is clearly no recompense for the expense and inconvenience suffered.

Obviously this psychic is wholly averse to publicity. Only the dearth of material leads her to offer her aid to our committee, and only then subject to conditions. One of these is anonymity. I don't know what we shall do about this if she wins our prize; certainly right up to that moment we shall do all we can to conceal her identity. For her we shall employ the name "Margery;" for the brother "Chester." The husband will appear in our pages as "F. H."

In investigating such a promising case as this, our April issue obligates us to meet the medium's expenses. Margery doesn't want it so. She is able to pay her own expenses, and ours; and she insists upon this. Her home is as accessible from Boston as from New York; and since the Boston members of our committee have had nothing to do, we shall for the present leave the case to them. Whether they go to the medium or she to them, she pays the freight, as well as that imposed by my presence in either place. And she specifies that if she wins our prize, it shall be used as a fund to defray the expenses of further investigation with further mediums.

It has been suggested that my social contact with Margery and her household, our freedom from operating expense in examining the case, etc., may be regarded as disqualifying us from its impartial consideration. I should think we might with equal plausibility be charged with a tendency to judge it too severely, in the effort to discount these factors; but in any event, the fact which now becomes obvious, that we are wholly aware of this angle of the case, ought to present every reasonable guarantee that we shall steer safely between the Scylla and Charybdis which it affords.

The sittings on which I base this preliminary outline of the mediumship have been held mainly in Margery's home. On the top floor a room has been set aside for the purpose. Chester urges that it be kept dark during the day, that shifting of the furniture and dusting be minimized, etc. He says he has a lot of super-physical apparatus there, which gets disarranged when the room is invaded.

The medium sits in an open-face cabinet, with black walls at sides, back and top. A plain table stands close in front. Sitters in appropriate number draw up to this and with the psychic form a circle, hands joined; any further sitters are placed promiscuously outside the circle.

Chester uses music freely to maintain the psychic atmosphere. Originally the victrola stood just outside the door, and required manual operation. On one occasion when a hymn was demanded, the gentleman in the hall blundered, and the darkness rang with the classic strains of "Yes, We have No Bananas!" Now the instrument stands in the room, with electric connection and repeater, so that it plays without attention throughout the sitting. Total darkness usually prevails, but provision is made for variable red light, and for white.

OUR effort to remove some of the material obstacles in the way of the appearance of the better mediums before our Committee on Psychic Investigation has had numerous responses. We have selected for our first attention the case that seems to offer the largest presumption of results of value. The medium is the camouflaged lady of the adjoining photograph; one of the "extras," obtained by a British psychic photographer, is recognized as "Margery's" brother who controls her sittings. Foremost among the heavily favorable moral factors in this case is the fact that the medium is free from financial responsibilities, and has therefore never permitted this element to enter her seances. Indeed, even if she wins our prize she will not transgress her habits in this respect; for she specifies that in this event, the money shall constitute a fund to defray the expenses of further investigation with further mediums.—THE EDITOR.

Chester's original means of communication consisted of taps—an elaborate code, running as high as seven. At first there was no trance; but a semi-trance condition was soon developed, to facilitate Chester's use of the automatic voice. Later he adopted a hoarse whisper which is accepted by the sitters as independent. I have at times had the strongest impression that this did come from unoccupied territory, but a whisper is the hardest sound to locate. In any event, the present account aims rather at statement of claims than presentation of evidence—that will come later, out of our committee's sittings.

Movement of the seance-room table has been of the standard types: mere shuffling, conceded to be of slight value with all the hands on the table and struggling to follow it; actual tilting, of perhaps somewhat more significance; and occasional full levitation. The tilting table has often been employed as an alternative to the raps, using the same code; and the shuffling table provides a convenient means of greeting or singling out individual sitters.

More out of the beaten path were the musical sounds which were being presented last fall. Chester had a favorable bar from "Souvenir"; and after the party was assembled in the seance room, his coming would be heralded by the whistling of this, loud and clear, somewhere below—often in several quarters, apparently progressing upward. At ten o'clock would be heard what Chester called his "wee watchie"—the gentle striking of a psychic clock, heard as from a distance. And at the end, his departure would be signalized by "Taps" on a psychic bugle.

The most careful search of the house which could be given without actual dissection failed to reveal any instrumental agencies for these noises; and beyond their mere occurrence, there never was any evidence of the presence of an intruder. The sounds persisted when the psychic's young son was loaned out for the evening, though it was usually necessary, in default of any proper place to send him, to put him to bed and lock him in. The two servants were sometimes sent to bed; sometimes locked in the basement; sometimes sent to the movies, and obliged to pound the pavement from the termination of the last show till the end of the seance. After the introduction of radio into the house, it was always disconnected for the sittings. A good effort was made to rule out the physical possibility of fraud in connection with these remote noises, but in the nature of the case this was almost impossible.

The victrolas were stopped and started, shifted back for repetition, etc., under a wide variety of circumstances. This occurred usually with the seance-room machine, Chester merely relieving the sitters momentarily. But it often involved a change of tempo or of tone, quite different from anything produced by ordinary regulation. And it was sometimes a formal episode, affecting the instrument downstairs in the main hall while the sitters watched in good light.

This followed a curious technique which I have met in no other circle. At some time during the seance, Chester would order the medium, alone or with some of the sitters, to go downstairs. He would give instructions just where each person was to go, with full details of their behavior; and he would outline what was to occur psychically. These announcements were usually made good, though default was experienced. Not only was the downstairs victrola thus manipulated, in plain view of all, the needle being swung into accurate place without visible physical means; but the grandfather's clock on the stairs, though locked and the key safeguarded, was stopped and started, and its chimes and gong omitted or suspended. Sometimes several clocks would be stopped simultaneously, or at hours chosen by the sitters. Movement of furniture on the lower floors likewise occurred under this procedure, tables and stools marching while the sitters, brought downstairs for the purpose, watched in fairly good white light.

All this was, of course, highly objectionable from a critical viewpoint; it was bad enough to have the entire house for theatre, without having the medium wandering about unattended. Nevertheless, the case was sufficiently impressive to have had the attention of a group of serious investigators. For the fraudulent production of what they had seen, a confederate seemed both necessary and sufficient. On various grounds the "scientists," as Chester and his sitters dubbed the group, had committed themselves to this idea, though undecided as to the identity and *locus operandi* of the oblique contributor.

At the moment of my arrival in November a climax had been reached. There had been movement of a piano stool across the front room, while the audience watched from the dining room—a favorite arrangement. The stool had gone in a straight line, toward a disused register which had been made over into a vent, opening directly into the cellar. The possible inference seemed fully supported, and the case against Margery completed, when it was announced that the junior scientist had recovered a piece of string from the stool leg. He had possession of this exhibit; but Margery handed me a string which he subsequently admitted was of identical material. Asked what I should think if I found this on the floor, I replied unhesitatingly that I should probably take it for a raveling from the

carpet. I was then shown the spot where its duplicate had been picked up. The rug here had a fringe which, if one so much as stepped on it, came off in pieces of exactly the appearance and uniformly the length of mine. I should certainly not expect to drag a stool across this fringe without detaching one or more segments.

Mr. Junior Scientist eventually admitted that his exhibit was such a fragment; and he insisted he had never stated that it came off the leg of the stool—merely that he had picked it up near the stool. He had been quoted by one of his colleagues as having found it "attached" to the stool. I take it for granted that he did not deliberately falsify; whether he said more than he intended or whether he was simply misunderstood I don't know.

Of course a clever medium, requiring a string to haul the furniture around, might use one that would match the fringe on the rug. It would be extraordinary if the guilty fragment that broke off should be of exactly the right length; but even so, if the medium is as clever as that, the investigator must expect to be correspondingly cleverer, and to prove either that his exhibit *isn't* a piece of the fringe, or that it *was* used to move the furniture. The senior scientist regarded the case as wholly reopened by these developments. His last word, uttered in consultation with me, might well stand as a text for psychic researchers: "I can't seem to impress upon these impulsive young men that they mustn't get ahead of their evidence!"

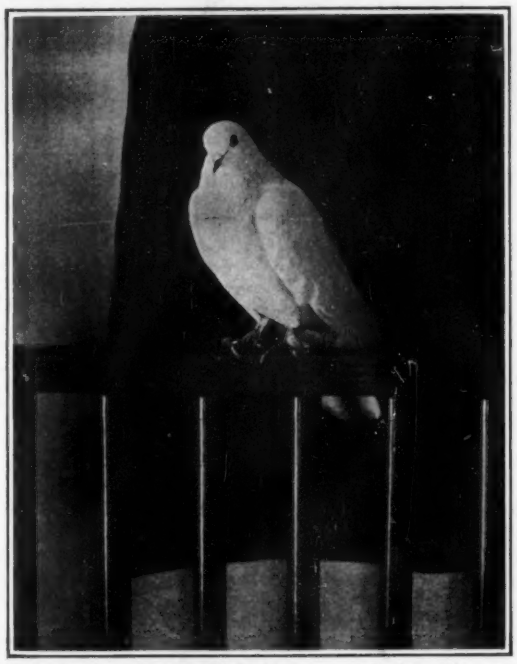
Now Margery is a very keen-minded person. If she wanted to indulge in a bit of sport at the expense of a group of investigators, I know no one with the mental resources to do it better or to get more sport out of it. My dominant impression of her is one of quickness, alertness; and she has a sense of humor as wicked as my own. My November visit was made a continuous circus by the fashion in which that confederacy theory was batted about the house, under her leadership. We would tip-toe around, looking under tables and in teacups for the accomplice. If we cracked one joke about strings we cracked a hundred. Margery would gravely point out this or that feature of the architecture or the furnishings, and gravely explain its role in her tricks. And so on, *ad lib.*

Of itself, this would point equally in either direction. A clever trickster couldn't do better than pass off the charge of fraud as a joke; she might even hope to occupy my mind with this joke to the exclusion of more pertinent things. But Margery was obviously greatly wrought up, though trying hard to conceal her emotions; it was impossible for her to talk of, or listen to, anything other than the fraud allegation for more than a minute at a time. She enjoyed the horse-play and seemed relieved thereby, but I regarded this as only a safety-valve. Her obvious suppressed turmoil did not impress me as mere reaction from the strain of fraudulent operation or the shock of exposure; while in discussion of the possible motive for the alleged fraud she gave indications of a controlled indignation which seemed very real. A consistent attitude of amusement, of crushed and bleeding innocence, or of righteous wrath, would have been incomparably easier to maintain fictitiously than this very impressive multiplicity of reaction.

Assuming genuineness, Margery sits too often. Thus, in the 26 days from March 12 to April 6, there were 20 seances, including one stretch of 11 consecutive evenings. The size and constituency of her audiences might also be criticized, and Chester himself complains of this variability. Since October more than 60 individuals have been in attendance; at least once the audience was so large that the report abandoned the attempt to list all those present. Whether through such causes or for another reason, the physical side was at low ebb in November. On Thursday we had the "Souvenir" whistle, the "wee watchie" and the taps; but when we trooped downstairs to see the big show we drew a blank. Chester communicated by faint raps and by tilting the table; and there was circular shuffling said to be very characteristic; but that was about all.

On Friday, as we gathered for dinner, the son of the house strolled in, whistling Chester's "Souvenir" melody with the utmost nonchalance. He said he had picked it up from Chester; he did it very well, indeed. Margery looked at me with amused despair: "Now, after that how shall I ever prove it genuine when Chester does it?" This facing of facts is typical.

On Saturday, as we sat at dinner, we joined hands momentarily to form a circle. Half an hour later the "Souvenir" whistle was heard from upstairs. The boy was accounted for; but of several intended sitters who had come in as we ate, I could not testify that none had gone upstairs. Confederacy, however, if it is to explain all that occurs, must do a prodigious lot of jumping about; repeatedly a person who seems the only possible vessel of guilt in one episode is absent or clearly innocent at another. Margery occasionally feels that some bizarre incident is not Chester at all, but some sitter trying him out to see whether he will



This is the pigeon which, if we may believe the reports, was brought by psychic power through the walls of the house

claim what isn't his. Though he has, through accident and through design, been given numerous opportunities thus to burn his fingers, he hasn't even got them hot, as yet. Often in the face of such a test he says flatly: "I didn't do it; who did?"

Chester had been slow to start on Thursday. On Friday there was a longer wait; after which the table moved only back and forth in a straight line, in a fashion clearly distinct from the usual circular motion. The regulars developed the conviction that not Chester, but some other personality, was responsible. The yes-and-no code was explained to this individual, and he was asked to jerk out answers with the table. To a wide variety of questions he replied always "No," even when this was clearly inapplicable. Opinion varied whether he wouldn't or couldn't jerk twice.

There came an interlude, during which it was afterwards agreed that Chester had been trying to warn us to break up the sitting. Then suddenly, without the slightest preliminary the psychic was in full trance. The usual symptoms were marked, particularly the icy hands. Two or three of the sitters were medical men of standing; they and I were impressed with the apparent physiological genuineness of the seizure.

The facial expression and the restlessness were such that the regular sitters identified the possession as an evil one. Thrashing of body and limb became pronounced, and the head jerked violently. Uncouth sounds were mouthed uncouthly. Suddenly, with a vicious snarl, the words "Get the Hell out of here!" were formed. It was assumed that the disturbance was caused by Chester's effort to expel the evil presence, and that this unladylike remark was the intruder's rejoinder. After some 15 minutes physical calm ensued, and presently the medium awoke, a bit bewildered that she had been "asleep," but otherwise normal.

All this was quite orthodox. The spiritualists, whose doctrines are accepted although their religious aspects are ignored in this group, believe that the spheres outside our own are populated, not alone by deceased humans and beneficent beings, but equally by numerous evil intelligences, ex-human and others. They believe these evil spirits invade the seance room and seek to get control; they believe the good spirits resist this; and they draw a vague but none the less alarming picture of the possible serious consequences to the medium.

Saturday's sitting was devoid of all physical features save movement of the table, mainly by the stranger. This time we got a good deal out of him. He continued to shove the table in straight lines, but was now able to pick out individual sitters with it. There were indications that he was especially interested in me; and we got pronounced reactions out of him on several questions and remarks. By running off the alphabet we tried to get his initials. He seemed confused, contradicted himself, and finally refused to proceed. Had I been disposed to do so, I could have identified him tentatively from all this, but he was not sufficiently evidential to force an unwilling identification. I refrain from more specific details; I do not want to invite his adoption by other mediums.

We stopped early; I walked out with two of the other sitters, and stayed long enough to give the regulars a chance to try it in my absence, if they would. They did, with great success. The table moved in Chester's characteristic fashion. The voice said there had been difficulty, and admitted that it was connected with me. The intruding spirit had come with me; he was on a plane lower than Chester's, and better able to reach us on that account. The situation was serious; but we might sit on Sunday, provided careful watch be kept for the signal to disband.

In its early part the seance thus authorized was eventless. Ultimately, however, Margery shot into full trance again, without the slightest warning; and S. T. (Single Tapper), as we had named him, was in command. The physical reactions this time were excessive. The medium kicked the chair out from under her and collapsed upon the floor, overturning the cabinet. The circle was maintained (this is considered of the utmost importance in the presence of such a seizure) with the greatest difficulty against her muscular spasms. Though various hideous throat noises were given forth, there was no coherent voice; and mental possession did not seem to proceed so far as on Friday. Nor did the episode last so long.

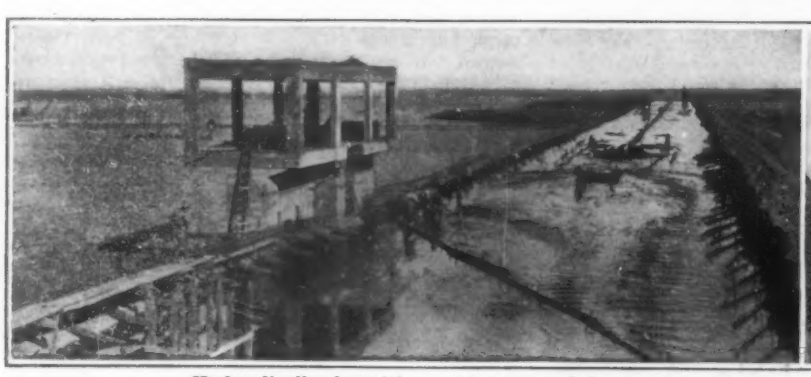
The hypothesis that S. T. was, consciously or subconsciously, a pure invention is this time amply and obviously motivated. Such fraud would be to avoid the necessity for giving the usual performance in my presence; and as well, through her husband's unwillingness to expose Margery to this malign influence, to provide an easy way out when it became too risky to go on at all. The "impulsive young men" were confident that we should have persistence of S. T. and abandonment of the mediumship. The one would surely have led to the other; the visitation had F. H. in a state of acute alarm.

If neither conscious nor subconscious fraud, S. T. represents in some sort a duality or an actual external possession. Comprehensive discussion is not possible here with our meager array of observed facts. Little opportunity was given him to establish an identity. So far as such judgment is feasible, I should say that he was not particularly continuous or self-consistent. Friday's single jerks impressed me, not as an attempt to communicate at all, but merely as an effort to create a disturbance; while Saturday's display, real or fictitious, was surely an attempt at communication. And I also saw a difference in the attitude of Sunday's trance possession, as against Friday's.

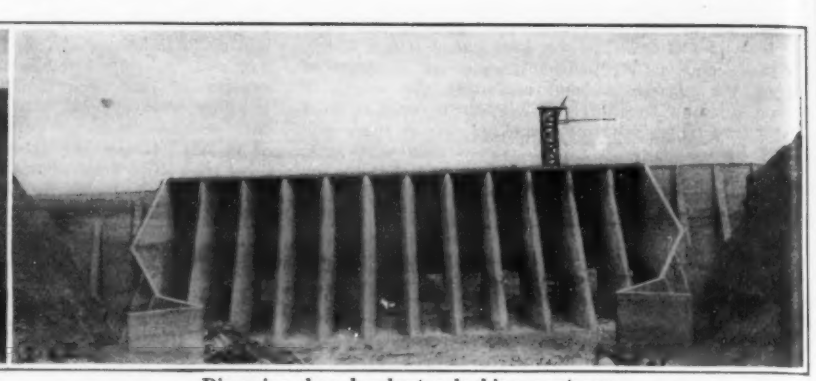
The apparent physiological validity of the trance would argue against conscious fraud, but not against the subconscious variety. Aside from his inherent confidence in his wife, F. H. felt that the largest improbability lay against her acquisition of the necessary data. She must not only know that such a seizure is good

(*Continued on page 70*)

IN THE cases of alleged physical mediumship which our Committee has met to date, I have found it necessary to preface my story with a few paragraphs making the reader familiar with the general features claimed to characterize the mediumship. Obviously this necessity exists in every case, since no two cases are closely parallel. With "Margery," our next medium, however, the initial probabilities of genuineness are much greater than in any previous case which the Committee has handled. Her mediumship is of such enormous apparent range, of such extreme import and importance if genuine, and withal so very interesting, that it becomes at once easy and necessary to spread the statement of what her manifestations look like over a complete instalment. I need not apologize for the absence of the critical attitude in the present story; obviously it is not called for here. It will be present next month, when I commence the story of the Committee's formal work with Margery—which at the moment of writing has covered several sittings, and which has been distinctly favorable so far as it has gone.—THE AUTHOR.



Hydraulically depositing center core of dam



Diversion dam headgates looking upstream

Wichita Dam

Completion of Another Big Western Irrigation Project

FIFTY-FOUR miles west of Wichita Falls on the Wichita River, there was completed during the spring months of this year an unusually large earthen dam, by means of which there has been formed a fine body of water which is known as Lake Kemp. The impounded waters are passed down the valley to a diversion lake, twenty-six miles west of Wichita Falls. From the diversion lake the water is fed into a canal system, through which it flows by gravity through the fertile valley of Wichita to Wichita Falls, where it will furnish an abundant municipal and industrial water supply.

The formation of Lake Kemp, with a capacity when full of 171,517,500,000 gallons, will give to the State of Texas the seventh largest artificial body of water in America; and it will be of interest, just here, to give a list of those large irrigation and power projects which are to be found throughout the hitherto arid regions of the western States:

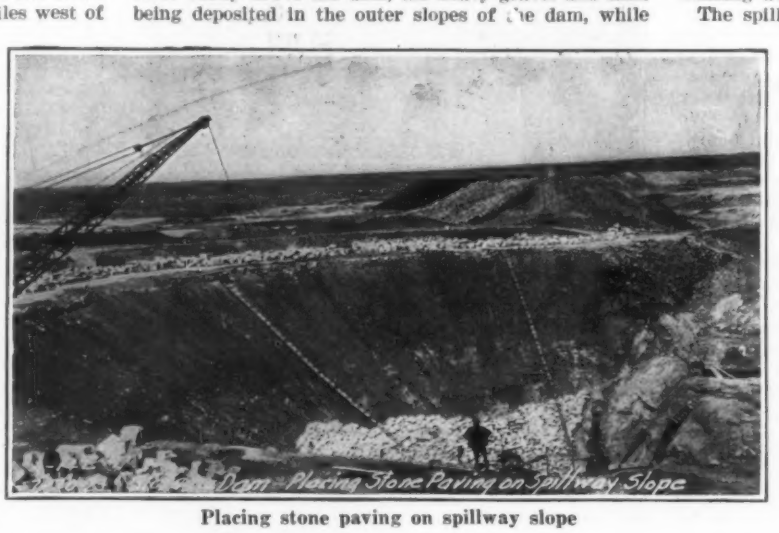
Pre-eminent among these are: Elephant Butte, New Mexico, with a capacity of 863 billion gallons; Roosevelt, Ariz., with 425 billion gallons; Winnibigish, Minn., with 338 billion gallons; Pathfinder, Wyo., with 327 billion gallons; Jackson Lake, Idaho, with 254 billion gallons; Leech Lake, Minn., with 247 billion gallons; Moosehead Lake, Mo., with 177 billion gallons; Wichita Project, Texas, the subject of the present story, with 171 billion gallons.

It should be mentioned that, in the passage of the water from the diversion lake to Wichita Falls, it is emptied in Lake Wichita seven miles above the city, which has been hitherto the source of the city's water supply. The present municipal system of water mains will not be disturbed, and the larger lake up the valley will serve as a perpetual insurance against a water shortage. The people of Wichita Falls will tell you that, although oil has made the city known throughout the United States, water is destined to make it still better known, since the new irrigation project will provide a water supply for a city of 250,000 inhabitants, and will irrigate 100,000 acres of fertile land in the Wichita River valley.

The most interesting part of this work, judged from the engineering standpoint, is the large earth storage dam which has been built by the hydraulic dredge "T. B. Noble." This great work rises 99 feet above the valley and extends across it with a continuous length of 7500 feet.

Gathering its water from a catchment basin of 2000 square miles, the embankment forms a lake with an area 21,000 acres at spillway crest level, at an elevation of 1150 feet above sea level. The length of its shore line is 125 miles; its greatest length extending up the valley is 20 miles, and its greatest width eight miles. The maximum depth of water near the dam at spillway level is 85 feet and the average depth is 25 feet.

The earth dam, as we have said, was built by the hydraulic method. The material was pumped from the river valley above the dam, the heavy gravel and sand being deposited in the outer slopes of the dam, while the central core which, during construction, was always maintained at the height of the dam, is composed of fine impervious silt, which was deposited in the central core pool between the side slopes. In this method of construction, the fine material settles down out of the pumped-in material and forms a compact mass which is impervious to the passage of water, thereby presenting a water-tight seal throughout the full length of the dam from side to side of the valley. It should be mentioned that, before the pumping in of the core-wall material, sheet piling was driven across the valley down to a firm footing, so as to prevent any seepage underneath the dam.



Placing stone paving on spillway slope

The top left-hand illustration on this page is taken looking along the axis of the dam, and shows very clearly the filling in of this core-wall, and also the top of the gravel and rock material on either side. The illustration at the bottom of the page, shows how the up-stream slope of the earth dam is protected against washing away by a covering of rock rip-rap.

The spillway, which is of the amphitheater type, is built of reinforced concrete. It is 12 feet high, 565 feet long, and surmounts a paved conical slope which terminates in the floor 90 feet below. The floor is 145 feet in circumference, and is paved with 36 inches of rock.

The diversion dam which is 26 miles west of Wichita Falls is 54 feet in maximum height, 4156 feet in length and has a storage capacity of 13,068,000,000 gallons. It is of similar construction to Lake Kemp dam, and contains 597,700 cubic yards as compared with 1,497,235 cubic feet in the Lake Kemp dam. The spillway of the diversion dam is 308 feet in length, and its capacity is 100,000 second-feet; and since the greatest recorded flood on the Wichita River is 15,000 second-feet, the diversion dam may be considered as amply protected against overflow.

The length of the south side canal which conveys the water from the diversion dam is 34.2 miles. Its bottom width is 32 feet, the depth of water 8 feet, and the width of water at the surface 64 feet. It has a capacity of 1000 second-feet for a distance of 16.5 miles.

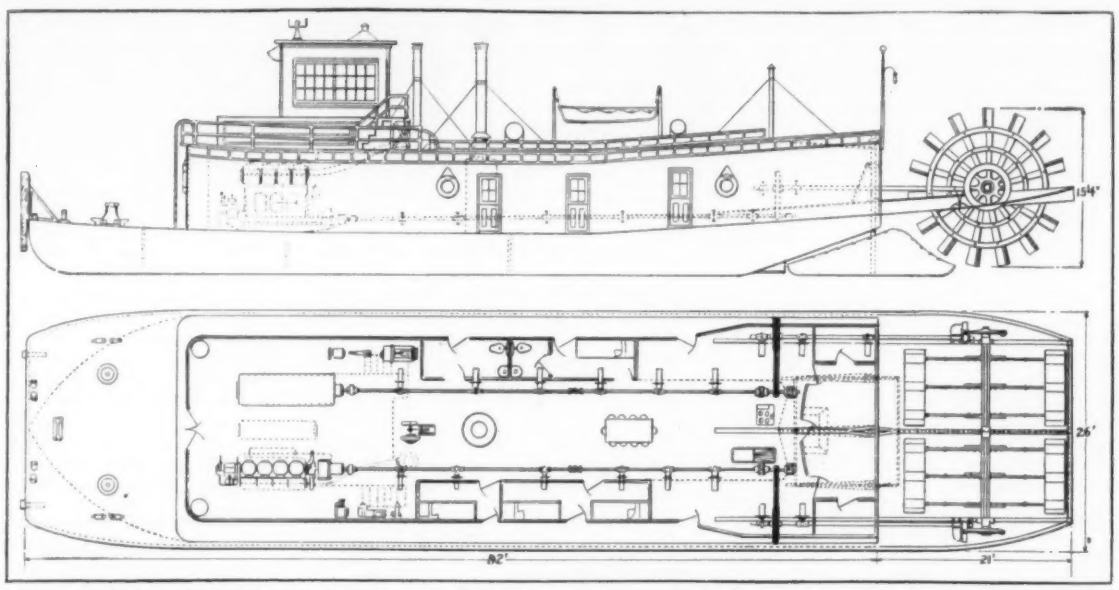
Wichita storage dam. Length, 7500 feet, height, 99 feet. Storage capacity, 171,517,500,000 gallons

Effect of Manganese on Plant Growth

CERTAIN elements that occur only in very small amounts in plant tissues would appear to play some definite part in the economy of the plant, according to a recent article published by J. S. McHargue in the *Journal of Agricultural Research* (British). The author investigated the effect of manganese sulfate on the growth of plants in water cultures with specially purified nutrient salts, and his results indicate, at least for the plants tested, that a very small quantity of manganese is essential to produce normal growth. Such plants as radish, soy bean, cow-pea, field pea, and maize do not contain sufficient manganese for growth to maturity, though some have sufficient for the first few weeks. The lack of manganese affects the production of dry matter and brings about an etiolated condition of the young leaves and buds, suggesting that the element has a function in photosynthesis and in chlorophyll formation. Experiments showed that manganese sulfate applied to acid soil caused a decrease in crop, whereas, if calcium carbonate was applied, in addition, increased yields were obtained.

Diesel-Driven Stern-Wheel Boat

HITHERTO, reliability rather than economy has been the chief consideration in the construction of our middle-western river steamers. The possibility of a stalling of the machinery and a steamer going over a dam has prevented the adoption, with but few exceptions, of that highly economical drive, the Diesel engine. There have been a few installations of non-reversible Diesels on the western rivers, and herewith we illustrate the first "reversing at the engine" Diesel stern-wheel towboat, which was designed by W. Harvey Herbert of Nashville, Tenn. The owners of the boat have another steamer of about the same size and power, with which they were able to make comparisons of performance. The old steamer driven by steam engines of the normal type show a consumption of 7.9 pounds of coal per horsepower per hour, whereas the Diesel engine does the same work on one-half a pound of fuel oil per horsepower-hour. The daily fuel and lubricating oil bill for the steam-driven steamer is $40 per ten-hour day, compared with $9.50 for the Diesel, all these figures being taken from the owner's records. Further economy is found in a saving of two men in the operating force, combined with a saving of time in fueling, the approximate saving reaching 154 hours per year.



Profile and plan of the "Harvey," showing the two Diesel engines near the bow; the two line shafts; the two chain drives to the outboard shafts; and the paddle wheels

The "Harvey," as it is called, has a steel hull and a steel main deck, with a wooden superstructure. She has a rounded as against a scow bow, and is steered by three balanced rudders, each 18 feet long. Her dimensions are: length 113 feet; beam 26 feet, and mean draft 3 feet; and her speed light is about 12½ miles per hour. Fuel tanks sufficient for 120 tons are located under the engine room, and ballast tanks for trim are fitted forward. The cost of the boat completely equipped is about $50,000.

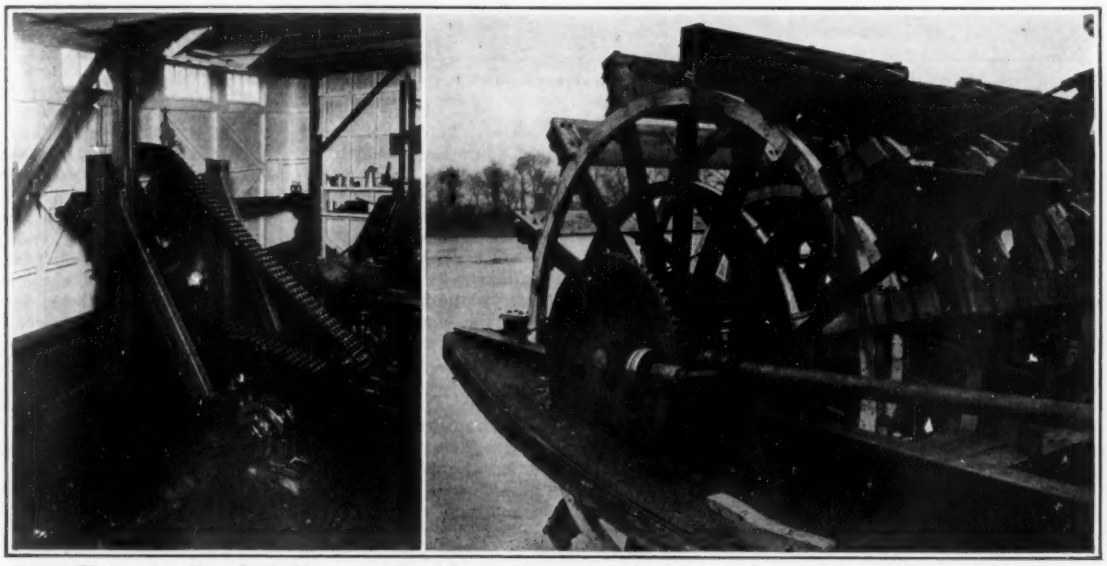
The propelling machinery consists of two Worthington Diesel engines, four-cylinder, two-cycle, solid injection, direct reversible marine type of 120 horsepower each, at 375 revolutions per minute. Line shafts, as shown in our drawings, run aft from each engine to a point above ten feet forward of the stern, where there is a sprocket and chain drive connected up with a fore-and-aft outboard shaft, which is driven at 74 to 78 r.p.m. This shaft in turn, through bevel gears, operates the stern paddle-wheel at about 19 turns per minute. There are no clutches nor gear shafts used external to the engines.

The paddle-wheel is divided into two halves, the starboard engine driving the starboard portion, and the port engine the port portion. This affords excellent maneuvering, which can be accomplished with half the power and, if necessary, the boat can be operated with one engine. The paddle-wheel has a diameter of 14 feet 4 inches.

The first thing that strikes the observer of these engines is the absence of outside shafting, cams, and valve gear. The central parts are in a housing which encloses the forward end of the crankshaft. Each cam operates an air starting valve which goes out of action when the engine is on fuel. Eccentrics drive the fuel injection plunger pumps, which deliver the fuel to spray valves in the top of the cylinders. The entire engine unit with all essential auxiliaries is self-contained.

For almost one hundred years the vessel propelled by a stern paddle-wheel, rotated by massive wooden connecting rods called Pitmans, from long-stroke, single-cylinder, non-condensing engines, has proved its reliability on our western rivers, and the stern paddle-wheel has little to fear in competition with propellers when the boat is in shallow water; for while a tunnel stern may solve the problem of driving ahead, it does not compare with the stern wheel in effectiveness when backing.

The day has come when the old long-stroke, non-condensing, high-pressure engine, with its extravagant consumption of coal, will be displaced either by up-to-date steam installations comparing in efficiency with land practice, or it will be driven by Diesel engines. The pilot of this boat, with a life-time experience on river steamers, claims for her greatly superior facility in maneuvering, and this, coupled with the economy of one-half a pound of oil per horsepower hour, will commend itself to western river steamboat service.



Left: **The engine line shaft (foreground) with sprocket-and-chain drive to fore-and-aft outboard shaft.** ***Right:*** **Outboard shaft, driving paddle-wheel through bevel gear. The paddle-wheel is in two halves, each driven by its own Diesel engine, as will be noted from the plan drawing above**

Local Immunity in Infectious Diseases

THE usually accepted view that protection against pathogenic bacteria is due to the development of specific antibodies in the blood is disputed by Professor Besredka of the Pasteur Institute. It is true that after recovery from any infection, or after inoculation with a vaccine consisting of the killed bacteria which cause this infection, the blood acquires properties which it did not possess before, for example, the power of clumping the bacteria or even killing or dissolving them. It was very natural to suppose that the development of these bodies in the blood is directly responsible for recovery from any infection or the failure of the particular organism to gain a footing in successfully vaccinated individuals. Professor Besredka realized, however, that in certain cases a definite protection exists without the occurrence of such bodies in the blood, and he was led to the belief that their appearance is a secondary and not a necessary sequel to a protection acquired by the special cells which the particular organism preferred.

In the case of anthrax, to which the guinea pig is very susceptible, Professor Besredka has proved by ingenious experiments that inoculation of the killed *Bacillus anthracis* into the peritoneal cavity or tissues other than the skin, is not followed by the development of antibodies in the blood, and that no protection against subsequent inoculation of the skin with living organisms is obtained. If, however, the killed organisms are applied to the skin, or in other words, if the skin is vaccinated, a definite immunity is acquired and the guinea pigs, which previously would have contracted a virulent infection by the inoculation of the skin with a very small dose of living bacilli, now are resistant to very large doses. This immunity is not associated with the appearance of antibodies in the blood. It is evident, therefore, that in order to obtain immunity against anthrax it is necessary to increase the resisting power of the special tissue, namely, the skin which the *Bacillus anthracis* favored.

Professor Besredka then turned his attention to other diseases, such as cholera, typhoid and dysentery, the organisms of which attack the lining cells of the intestine. If the same principle maintains in these diseases, then in order to produce an immunity it would be best to vaccinate the intestinal wall by bringing the vaccine of killed organisms in direct contact with it. Experiments on animals have shown that such an immunity can be obtained by administering the vaccines by the mouth Instead of injecting them subcutaneously by the usually accepted method.

Having obtained these results in animal experiments, attention was directed to human beings, and already certain data have been collected which can be interpreted as indicating that, during outbreaks of typhoid and dysentery, those who came in contact with the sick can be protected by the ingestion of tablets of killed bacteria. Another application of this principle which is being investigated is the possibility of vaccinating the skin of human beings against staphylococci, the cause of boils and furuncles. In these cases the organisms develop exclusively in the skin, and already evidence is accumulating that protection and even cure can be obtained by applying vaccines to the skin in place of inoculating them subcutaneously according to the generally accepted procedure.—*Abstract from article in Nature for February 16, 1924.*

The Great Lakes—St. Lawrence Deep-Sea Route

Huge Navigational and Hydro-Electric Plan Recommended by the International Joint Commission

TWO and a half years ago the Governments of the United States and Canada referred to the International Joint Commission for investigation and report, the advisability and the feasibility of a route for deep-sea shipping from the Great Lakes to the sea via the St. Lawrence River.

The International Joint Commission recommended in its report that the Governments of the United States and Canada enter into an arrangement by way of treaty for a scheme of improvement of the St. Lawrence River between Montreal and Lake Ontario.

We are informed that the estimated cost of the completed project between Montreal and Lake Ontario, as outlined by the engineering board, is about $252,000,000. To this must be added the cost of the New Welland Ship Canal, which would bring the total expenditure up to approximately $275,000,000. The two countries would share in this outlay. In the concluding paragraph of its report, the International Body says that the Commission has brought together authoritative information as to the existing traffic between the tributary area and overseas points as well as between the same area and coastwise points on this continent, and has reached the general conclusion that sufficient traffic will seek the new water route, irrespective of new traffic created as the result of the opening of that route, to justify taking up its construction.

Looking at the problem from a purely national point of view, we find that the region, likely to be benefited by more direct trade with the British Isles and western Europe, contains a very industrious and progressive population of about 42,000,000 people.

The value of all farm property embraced within the tributary area amounts to nearly $450,000,000,000, more than 63 per cent of the total of such property in the entire nation, and four years ago, this region produced cereals, seeds and grains to the aggregate worth of $4,850,000,000. Something in excess of 50 per cent of the domestic animals in the country are to be found in the territory in question. Quite 49 per cent of the capital invested in mine and quarries in the United States is centered here and in 1920, 83.8 per cent of our soft coal was obtained from the bituminous fields of this favored portion of our land. The largest iron ore producing States are Michigan and Minnesota, both contiguous to the Great Lakes. Together, these two States provide over 80 per cent of the iron-ore output of the union. In 1909, 54.7 per cent of the paper made within our boundaries came from some of the States that look to the St. Lawrence waterway for transportation relief. In conclusion, the money devoted to manufacture amounts to $19,000,000,000, nearly 43 per cent of that similarly ventured in the whole country; and of the total of 1,255,704,973 tons of freight traffic handled during 1920 on all Class 1 railroads in the United States, fully 56 per cent had its origin in this zone.

The International Joint Commission, after carefully digesting all of the evidence submitted for and against the St. Lawrence waterway, declares that well-nigh all of the objections to the undertaking and its practical operation are without foundation, and is satisfied that there will be no hampering sacrifice in time in passing through the locks and canals and restricted natural channels that would form parts of the system.

Further, we are told: "The Commission is inclined to agree with the statement that where there is a productive interior, ships will proceed as far inland as physically practicable, and that the farther inland they can penetrate the greater will be the resulting economy and the more extensive the area benefited." As examples of this, we are reminded of the considerable traffic by ocean-going ships which has developed on such rivers as the Amazon, the Yangtse-Kiang, the Rhine, the Danube, the Columbia, the Willamette, the Delaware, the lower Mississippi, and on an extensive stretch of the St. Lawrence itself. These and other facts of traffic are offered as warrant for the assumption that the all-water route by way of the Great Lakes and the St. Lawrence, even though it includes a lengthy inland run, will be a cheaper and, generally speaking, a speedier method of transportation than that offered by the present available combined rail-and-water lines.

Whether a 25-foot or a 30-foot channel be decided upon, the engineers of the Commission propose to make the St. Lawrence fit for deep-sea shipping. The engineering board divides the project into two principal sections—the international, from Lake Ontario to Cornwall, and the national or all-Canadian, from Cornwall to Montreal. Each of these again is subdivided. For the international section a composite scheme of navigation and power development is endorsed. For the national section, the engineers recommend only a navigational development, although they recognize the possibility of future hydro-electric installations.

For a distance of about 45 miles from Prescott to Cornwall, within the international stretch of the St. Lawrence, the river has a drop of about 91 feet, which is neutralized at the present time by four canals, located at varying intervals along the Canadian shore. The approved plan calls for the building of a canal on the Canadian side of the stream which would have a prism depth of 25 feet at low water. This canal would run from the head of the Long Sault Rapids down to Cornwall, a matter of about eight miles, and would have two lift locks, 860 feet long by 80 feet wide, with a depth of 30 feet on the sills, together with a pair of guard gates. One of the locks would have a lift of 48 feet and the other a lift of 31 feet.

For the purpose of concentrating the fall in the river so as to lessen the number of locks and to curtail the mileage of restricted navigation, the engineers would construct a series of dams across the several canals including a main dam from Barnhart Island to Long Sault Island; and a smaller dam from the head of Long Sault Island to the American shore. The last mentioned structure is expected to facilitate the generation of 56,000 horsepower of electrical energy. The main dam is also designed so that it may be utilized for the production of power; and it is estimated that the two dams in question should render practicable the development of about 1,500,000 horsepower.

Supplementing the foregoing, a control and protective dam would be erected about 20 miles up the stream at Ogden Island, on the United States side of the St. Lawrence. This dam would have a lock of the same dimensions as those at the Long Sault. It is believed that the execution of the outlined undertakings within the international section, including the work in connection with the inundated lands and the equipping of plants capable of delivering 1,500,000 horsepower, would call for an expenditure of $159,000,000.

In the national or Canadian section of the St. Lawrence between Cornwall and Montreal, a distance of about 72 miles, the river has a drop of approximately 134 feet, which is now overcome by the Soulanges and the Lachine Canals. The Soulanges Canal offsets three rapids, the Coteau, the Cedars, and the Cascades. The engineering board recommends a canal 220 feet wide, provided with two pairs of flight locks with a depth for the canal of 25 feet at low water to be located on the south side of the St. Lawrence.

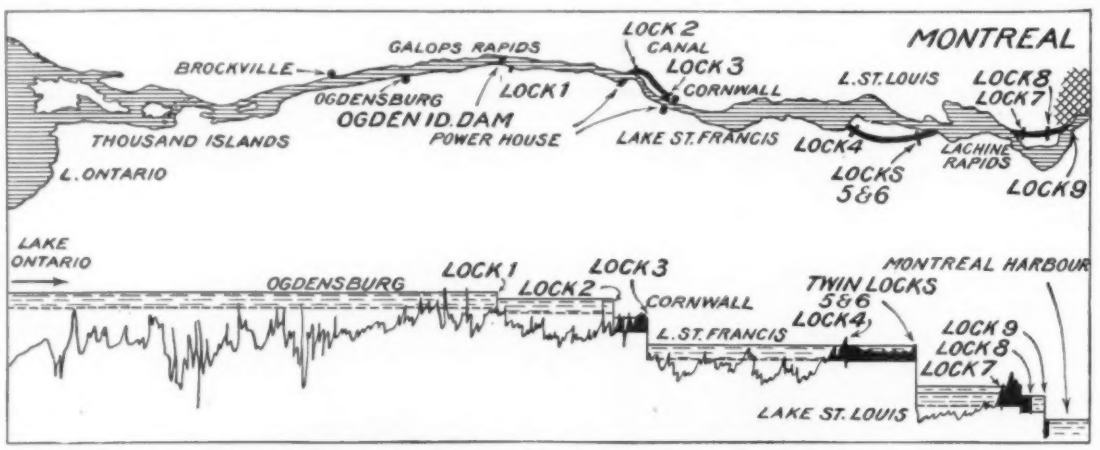
The existing Lachine Canal, 8½ miles from end to end, neutralizes two rapids, the Sault Normand and the Lachine Rapids. The plan would be to sidestep both rapids by a canal substantially eight miles long having two lift locks, like those just referred to, and a single guard lock. The combined lift would be about 48 feet. The contemplated canal would follow for a part of the way the same general route as the present artificial waterway, but for the remainder of the stretch the new canal would run mainly along the southerly and the westerly outskirts of the city of Montreal. In addition to the two projected canals, it would be necessary to do some dredging in Lakes St. Francis and St. Louis.

All of the undertakings in the canalized national section of the St. Lawrence, as well as the construction of certain protective works in the harbor of Montreal would call for an investment of quite $93,000,000. However, should the depth of the canals be increased from 25 feet to 30 feet an extra outlay of $17,000,000 would be needed. This supplemented sum would pay for the five feet of added depth for all three proposed canals in both the national and the international sections of the river. The annual disbursements for the operation and the maintenance of the entire scheme would, so it is estimated, not exceed $2,562,000, of which $1,105,000 would be chargeable to navigational requirements and $1,457,000 would be checked against power. The engineering board is of the opinion that 2,260,000 horsepower could be developed in the national section of the undertaking, should this be deemed desirable in the future; and the incidental hydro-electric installations could be made for $220,000,000.

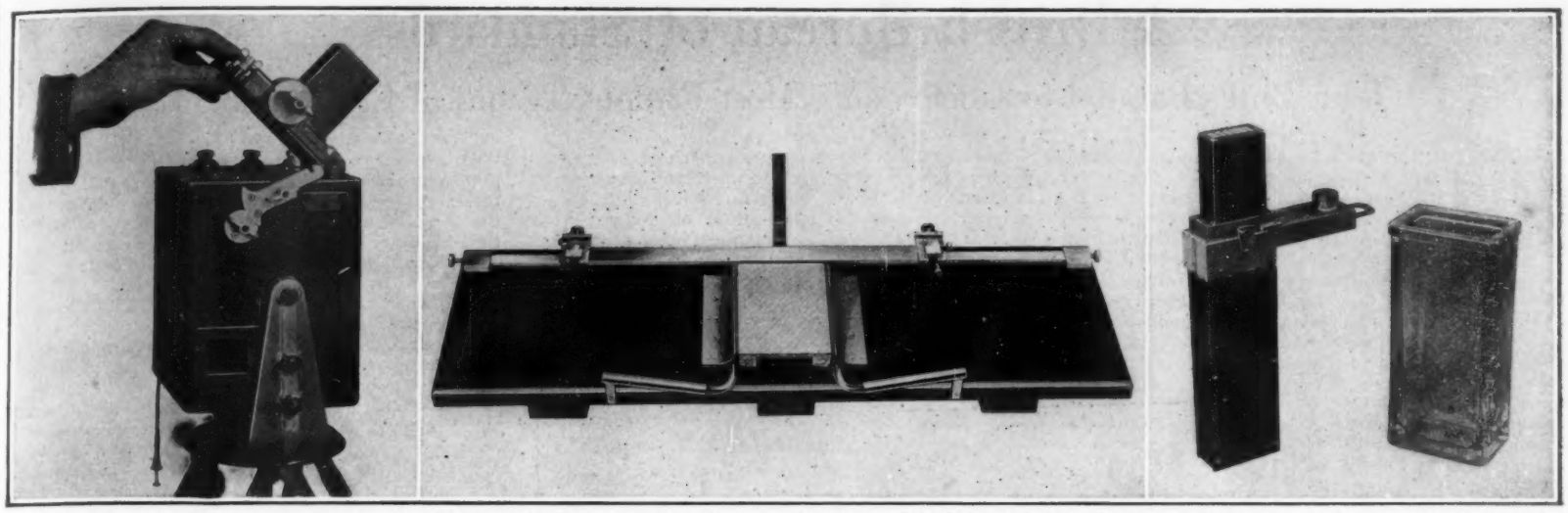
It is claimed that high potential energy so generated could be distributed throughout a radius of 300 miles with a loss in transmission of not more than 6 per cent. We are told that current produced at the projected plants might be sold under favorable circumstances at a rate of $26 per horsepower per annum. The director of the United States Geological Survey has said, "The demand in New York and New England would take care of all the power that might be developed on the St. Lawrence as soon as it was made available." Such, too, is the opinion expressed by the technicists who favor the creation of the superpower zone.

Knowing the rigorous characteristics of the St. Lawrence during the cold months, the layman is likely to ask, "Won't the dams, etc., add materially to the gravity of the ice situation and its menacing reflexes by hampering the movement of the ice? Upon this subject the report of the International Joint Commission contains this paragraph: "The ice question in connection with such a river as the St. Lawrence, with its immense volume, varying currents, and severe winter conditions, presents one of the most difficult problems confronting engineers in designing works for its improvement. With the river in its natural condition ice jams have occurred in the past that caused immense damage, and with the introduction of artificial works, unless these are very carefully located and designed, the opportunities for ice trouble are accentuated. It is anticipated that the works recommended will have the effect of greatly reducing the formation of anchor and frazil ice in the critical section of the river from the upper end of Lake St. Francis to the head of the Galops Rapids."

From an engineering viewpoint, there is apparently no insuperable obstacle to carrying out the scheme recommended by the Commission. The whole project, therefore, resolves itself into a matter of economics for the interested public of the two countries.



St. Lawrence Canal. The proposed deep-water channel between Lake Ontario and Montreal



Left: The camera in which the plate, in conjunction with three color filters, moves into three successive positions behind the single lens. At the top of the camera is the magazine, containing the plates. *Center:* Special arrangement used to superimpose and register the constituent prints. *Right:* Magazine in place on the developing tank for daylight manipulation, and the glass rinsing tank. This method of making natural-color photographs has been simplified so as to make it workable in the hands of the amateur photographer

Photographs in natural colors by a simple, fool-proof process

Bringing Color Photography Down to the Layman

YEARS have been spent in the attempt to perfect methods of making color photographs. Until the present the cameras for taking color photographs—exclusive of color motion pictures—may be divided briefly into two main classes, namely, the one class in which three lenses closely juxtaposed are used, and the other class consisting of a camera in which the subject is viewed through one lens.

In a process developed after ten years of experimental work by Mr. H. C. Deeks of New York, the latter principle is employed. The basis of each picture is a triple negative, *i. e.*, three successive exposures through three color filters on a single plate. The plate, in conjunction with the filters, moves into three successive positions behind the single lens. The camera is practically fool-proof, as it is operated by numerous keys which are numbered in sequence of operation, and they cannot be operated except in their proper order of numeration.

Besides the special camera, this process includes methods of development and printing which also appear to be almost fool-proof. A rather ingenious method of development makes a dark room unnecessary. The magazine, in which the exposed negatives are semi-automatically placed during the operation of the camera, is placed on the top of a metal daylight developing box, the bottom of which is perforated in such manner as to make it absolutely light-proof but not liquid-proof. The magazine cover is removed, and the plates slide down into the box, which is then placed in the developing chemical. At the proper time the box is placed in the fixing bath, following which rinsing is effected by plunging the box into water. Thus it is unnecessary to look at the plates until the fixing is completed; and the plates are thereby protected against premature exposure.

The printing process, which gives any number of 5 by 7 color pictures from the three 1 by 1½-inch negatives found on each plate, is an ingenious application of the carbon process. The developed plate with the three negatives, each screened for a different color, is placed in an enlarging camera, and the three images are projected on a special color sheet, which is of celluloid carrying three patches of bichromated gelatine, each the size of the desired print. The color arrangement is, of course, complementary to the screenings of the negatives. Following the desired exposure, this sheet is developed by merely immersing it in plain hot water and permitting it to dry. On it now appear three prints, one pink, one yellow, and the one blue, which are ready to be superimposed on the final support, or "combining board."

One of the prints is moistened and pressed lightly against a sheet of paper which is stretched over a metal block on the board. When quite dry, the celluloid is readily stripped away, leaving one of the positives in color on the paper. The second and third prints are registered upon the paper similarly by superimposing. It is well known that the superimposing of constituent prints is rather a ticklish proposition; but as they are in this case supported on a celluloid sheet which is stretched taut in a frame, it becomes easy to obtain accurate register by means of a micrometric adjusting device on the board. The result is a picture in the colors of the original subject.

Due to the transparency of the pigments used, which are different in this respect from the older carbon pigments, the completed pictures possess a richness and depth that are gratifying; and there is an absence of the predominance of the topmost film. Naturally any number of pictures may be made from the one triple-negative plate, a fresh color sheet, of course, being exposed and developed for each picture.

The three images on the negative of the color-photograph process

The chief advantages of this process of producing color photographs are the obtaining of filtered negatives from one viewpoint through a single lens; the impossibility of error in the operation of the camera, since the keys can be operated only in their proper sequence; the positiveness of the method of developing of the negative plates; the ease of making and combining the constituent prints; and the great transparency of the colors, making for a realistic result.

The arm of the little fellow in this street-car advertising card is hinged so as to animate it. At the right is the electromagnet and "flasher" switch for animating the card when used as a window display

Social Significance of the Army Intelligence Tests

PROFESSOR P. E. DAVIDSON discusses in the *Scientific Monthly* some of the generalizations which have been drawn from the now well-known American Army intelligence tests. These tests, originally applied in order to differentiate men for different Army posts, disclosed the unwelcome fact that large numbers of the population ranked very low in innate intelligence. Some writers have concluded from this that the traditional democratic ideal must be renounced, as only a gifted few are capable of ruling. The writer of the article believes, however, that three assumptions have to be made if such conclusions are sound: (1) that the Army draft was truly representative of the American population in general; (2) that the tests were really tests of native ability and not of educational advantages; (3) that the native intellect in question is so general as to condition social success of any significant kind. He gives reasons for disputing each of these assumptions, and shows that large numbers of the more intelligent members of the community were unrepresented, that the tests made heavy demands on language knowledge, and that many factors other than native ability help to determine a man's social position. While agreeing that the gifted minority should have every possible advantage, he disputes the belief that these alone should be trained, while large numbers are to be denied training because of an arbitrarily imputed stupidity. The article gives a salutary and timely check to the ardent enthusiasts who would impute to tests more than they can legitimately bear.

Animating the Advertising Card

REALIZING that after all is said and done, there is nothing like motion to attract the eye, a practical advertising man has worked out a simple method of animating advertising cards and window displays. His method is nothing more elaborate than cutting out part of the picture and mounting it in a delicate manner by means of a delicate spring. When used as a street-car advertising card, the vibration of the car is depended upon to actuate the delicately mounted member, thus securing the desired animation.

When it comes to using the same kind of card as a window display, this practical advertising man again resorts to a simple expedient. He merely fastens a small piece of iron at the rear to the moving part and places an electromagnet behind the card, in such position as to attract the moving part. The electromagnet is connected with 110-volt direct current or with a battery through a "flasher" or switching device, which makes and breaks the current at regular intervals and thus agitates the animated advertising sign in the absence of the driving power of vibration.

A British Bureau of Standards

John Bull's Parallel to Uncle Sam's Most Famous Technical Establishment

THE United States has its Bureau of Standards, at Washington, which is familiar to every reader of this magazine, if not to every one whose literary exposure stops with the daily papers. And Great Britain has its National Physical Laboratory at Teddington, just a half-hour's run from London. The parallelism between the two institutions is very close; the members of the Teddington staff themselves, in the attempt to impress upon the American visitor just what their establishment is and what it does, invariably employ some form of the statement that it is the British analogue of our Bureau of Standards—or even that it *is* the British Bureau of Standards. That the comparison is a fair one was the impression which a member of our staff got when he went over the place a year ago, and should be the message which the reader will get from the pictures of the facing page.

As for our specific views, No. 1 shows a gear-measuring machine that is used for checking the accuracy of high-precision gears, whether cut or ground. A very accurate pantograph reproduces the shape and position of the teeth upon a smoked plate, with an accuracy better than the ten-thousandth of an inch. And as though this were not a sufficient achievement, the view of the gear thus obtained is magnified optically by fifty diameters, in order to make easy and certain the detection of any defects, however minute.

Among the special machinery is an apparatus used for investigating the endurance of automobile springs under vibration. The idea here is not to determine the liability to breakage under the extreme shock which occurs once in a month or a year, but rather to learn how the spring will stand up under the ordinary stress of the millions of small compressions and flexions that constitute its daily routine. An essential feature here, of course, is to know accurately how many vibrations the testing outfit imparts to the spring in a given interval of time; and our second view shows the process of checking the vibration counter. It will be noted from the contour of the spring that the test doesn't have to stop for this.

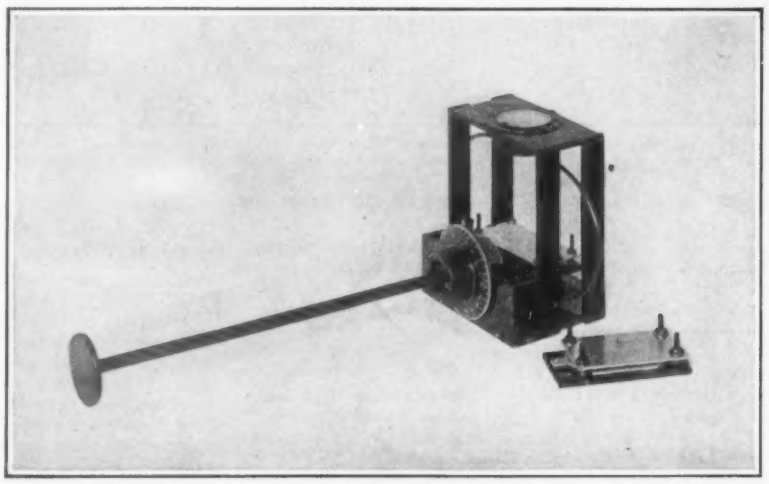
Industrial illumination is one of the important subjects of investigation, these days; and it of course depends entirely upon the amount of light received from natural sources, as determining the volume of artificial daylight which must be supplied. Our third picture shows the process of measuring the daylight illumination received from the four quarters of the sky. A special screen and photometer are used; the screen that receives the light being the upright structure at the right of the photograph, while the photometer is in the tube into which the operator is looking.

The Teddington laboratory has to deal freely with metals, and our next photograph shows the high-frequency electric furnace, for melting them down. Heat is generated by an electric current induced in the metal to be melted itself, by means of high frequency currents circulating around it. There is no direct metallic connection between the two, and hence no electrodes and no destructive arc. The small, white, box-like article in the center of the picture is the furnace. The assistant bending over it is wearing goggles of special glass, to protect his eyes from the heat radiated through the observation window. This in itself suggests the solution of a pretty problem—the compounding of a glass that would be sufficiently transparent to light waves and sufficiently opaque to the shorter radiant heat impulses for this service.

The circular picture to which our engraver attaches the number 5 will need no interpretation to those familiar with the technique of the Johannsen and Hoke gages for measuring in millionths of an inch. This is a master machine for gaging the gages that do this delicate work.

Our sixth view shows the radiation pyrometers that do, for high temperatures, the work which is done on the front porch by the family thermometer. These instruments record the temperature of a furnace by means of the effect on a small thermopile of the heat radiated through an observation hole in the side of the furnace. The view shows a series of these instruments being checked against one another with the aid of a large gas furnace.

Last in the group is another old friend, the column-testing machine. This is used for testing the strength of columns of iron, steel or concrete, such as are used in the construction of large factories and buildings throughout the country. This machine will accommodate columns up to the length of twenty feet, subjecting them to pressures as high as sixty tons per square inch.



The ultra-frequency wavemeter, that determines frequencies in the twenty- and thirty-thousands, and wave lengths as low as nine meters

Applying the Yardstick to Radio Waves

EXTREMELY short wave lengths or high frequencies —ranging from 9 to 16 meters or 33,000 to 19,000 kilocycles—have been actually measured by the Radio Laboratory of the Bureau of Standards, United States Department of Commerce. F. W. Dunmore and F. H. Engel, who conducted these pioneer experiments for this Government bureau, in a manner, made measurements of very short radio waves with quite the precision that the yardstick is applied to a bolt of cloth.

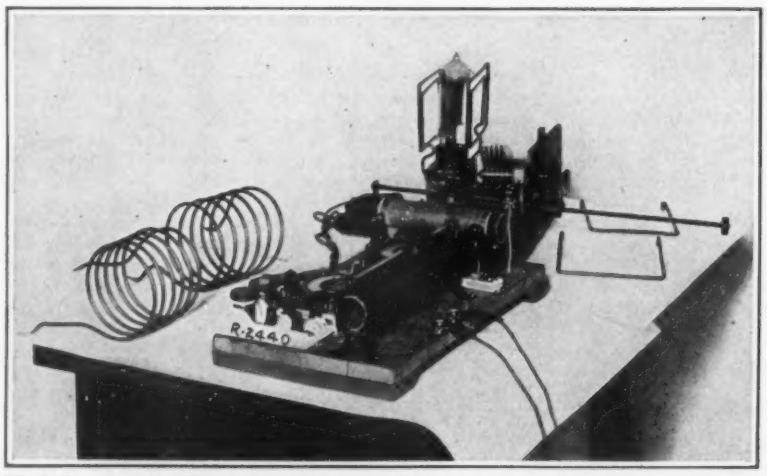
The use of two parallel wires coupled to a specially devised radio-frequency generating set was the means employed in applying the yardstick to radio waves. The two coils used in this generating equipment—one for the plate coupling and the other for the grid coupling—were spaced 1.18 inches apart. A radio-frequency by-pass condenser was used for varying the wave length slightly. A three-electrode, coated-filament type of electron tube was used in the generating set, this having a rating of 50 watts. The capacity between the three elements of this vacuum tube together with the two coils coupled to the grid and plate constituted the oscillatory circuit. Three choke coils stabilized the generating outfit and barred the radio-frequency currents from the battery circuits.

The two parallel wires, by means of which standing radio waves were actually measured, were of bare copper strand, 45 feet long, and were strung between glass insulators. The parallel wire system terminated in a wire loop. The two parallel wires, furthermore, were separated about 1.58 inches and held taut by two heavy springs. The outfit for generating the ultra radio frequencies was linked to the looped end of this parallel system of wires. A control panel was available for maintaining a constant output of the generating circuit.

A sliding thermo-galvanometer was, in a sense, the yardstick used in measuring these high radio frequencies or extremely short wave lengths. This sensitive device was suspended from the parallel wires and when slided along these wires maximum indications of current were noted. Then, after the maximum-current point was marked, the galvanometer was moved along the wires until a second current maximum was reflected. The distance between these two points of greatest current was accepted as one-half of a wave length. A calibrated steel tape was used for measuring distances on the parallel wires. A series of measurements of wave lengths of the brevity of nine meters indicated a variation of only one millimeter in 4.5 meters.

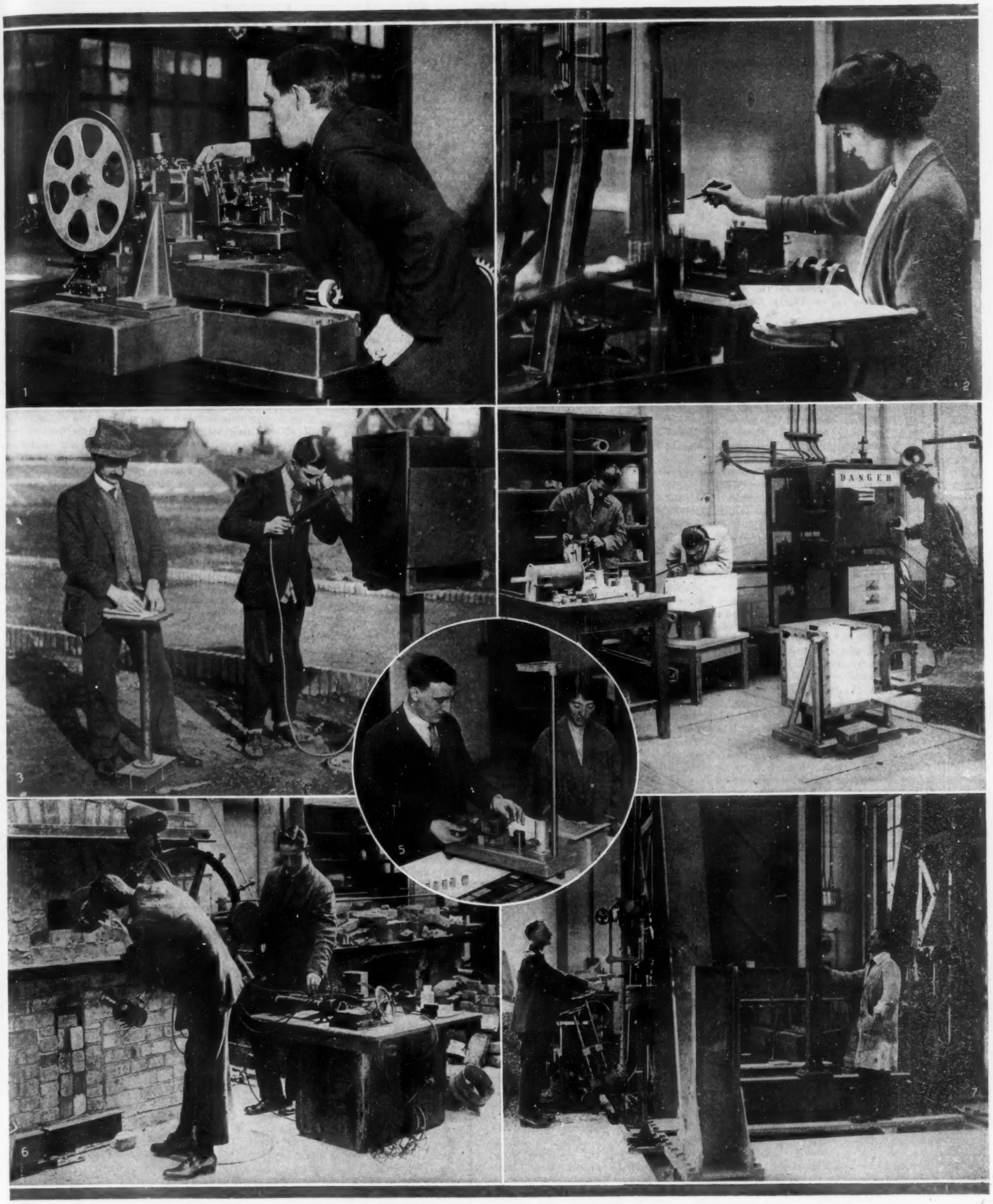
These pioneering experiments demanded the use of a specially designed radio-frequency wavemeter, which is shown in one of the photographs. This instrument had a range from 8.5 to 9.5 meters or from 35,000 to 32,000 kilocycles. It was calibrated by means of the parallel wire system, already described, when it was located on the roof of the Radio Laboratory of the Bureau of Standards. This ultra radio-frequency wavemeter consists of a single turn of extra large and heavy copper wire, the terminals of which were connected to a 50 micro-microfarad two-plate variable air condenser. The two fixed plates were spaced 3/64 of an inch apart. A thermo-galvanometer was inserted in series with the one turn of wire of the wavemeter.

The novel experiments in measuring and standarizing short radio waves also required a special type of receiving outfit. This embraced a range of frequencies from 15,000 to 37,000 kilocycles or from 8 to 18 meters. The tuning element was comprised of one turn of number 12 B. & S. gage copper wire. The latter was connected to a 0.00025 microfarad variable air condenser. The terminals of this condenser were connected to the input circuit of the audion tube detector, with two stages of audio-frequency amplification. This radio receiving set was located five feet from the two generating sets during the course of the experiments. By tuning this receiving unit to the frequency of the ultra radio-frequency generating set confusion arising by the presence of the beat notes in the other generating outfit was eliminated.



High-frequency radio generating set, which gives out waves of excessively short wave length, requiring apparatus such as that described for their measurement

With approximately 500 broadcasting stations in operation—functioning on a wave frequency of only ten kilocycles apart, and with even a closer margin for other classes of services, the possibilities of utilizing that little invaded band of frequencies between 10 and 105 meters cannot be well ignored. And, if this band of high frequencies is to be brought into service such wave lengths must be standardized. The pioneer experiments of Dunmore and Engel have indicated the ways and means of doing this. However, there still remain numerous problems to be solved in the practical application of the short wave length to transmission and reception in everyday work.

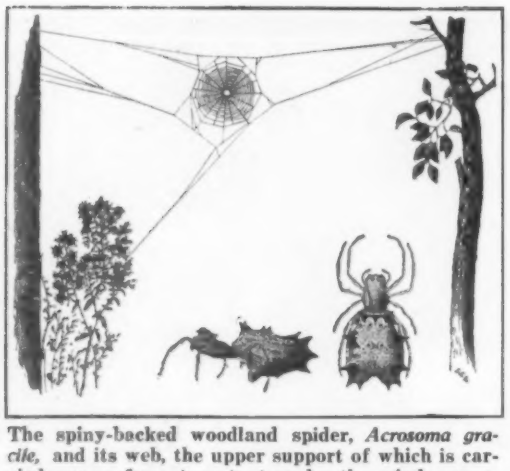


VIEWS FROM NATIONAL PHYSICAL LABORATORY AT TEDDINGTON, THE BRITISH EQUIVALENT OF THE UNITED STATES BUREAU OF STANDARDS—(See facing page)

The Earliest Engineers

How the Spider Applies Correct Principles of Cable Construction in the Fabrication of Her Web

By S. F. Aaron



The spiny-backed woodland spider, *Acrosoma gracile,* and its web, the upper support of which is carried across from tree to tree by the wind—sometimes as far as thirty feet

LONG before man attempted even to climb a grape vine and probably before his lemuroid ancestors were in existence, engineering feats in cable construction were commonly practiced by those many-eyed and eight-legged creatures known to systematic natural scientists as the Arachnida and, to the less technically inclined, as spiders. However generally insignificant or actually abhorrent these busy little animals may appear, their constructive skill should compel an admiring consideration. Even more laudable is their positive usefulness in consistently destroying many of man's most pernicious insect pests.

There are many groups of the Arachnida, most of them represented by common forms in house, garden, meadow and woodland, but considering only those with superior engineering ability we must deal with the orb weavers representing several families quite distinctly characterized, though with habits not very dissimilar. Amazons they are all, females with warlike inclinations as concerns the necessity for killing to obtain food; trappers and snare builders, for which purpose they lay long cables most expertly placed and anchored. Ingenuity—in largest measure hereditary, of course—is not too strong a term to apply to the always well chosen and adaptive methods for building these webs, often showing an individual study of effectiveness.

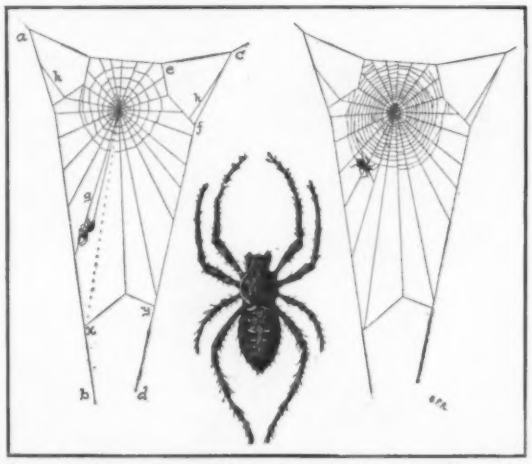
One of our garden spiders, *Epeira intersecta*, a common form within the eastern half of North America and occurring also in the West, is the builder of the most beautifully regular, geometric web which, more than any other, persists upon one plane with few bracing strands deviating from its flat surface. These snares are rarely over six or eight inches wide and twice as deep over the actual outline framing, though the supporting cables may extend down as much as six feet or more, depending on the height of the upper attachments above what may serve as an anchorage.

When a suitable space, generally among foliage, between tall weeds or sometimes dead and naked twigs, is selected—the term is used conclusively—the garden spider goes about constructing her web quite differently from most other allied species and to the observing human altogether unexpectedly. She does not at first lay the top cross strand, but depends upon two nearly vertical cables as supports, one on each side of the space selected. To the end of a firm leaf or twig she fastens the silken beginning of the strand that is formed behind her and drops vertically, anchoring this cable (*a-b*, in second illustration) to the first firm obstacle, perhaps upon the ground, or to a horizontal branch, upon which she crosses to the other side of the space, spinning no silk as she ascends, often by devious ways, to the height of the stretched cable opposite. Whereupon the process is repeated (*c-d*) the anchorages of the two vertical cables made nearer each other at the bottom than at the top.

Running up one cable to a chosen height near its top the little rigger fastens another line-to-be; then holding her abdominal spinnerets away from the cable she descends, crosses again and climbing the other side to a point once more opposite (*a*), takes in the slack of the just spun strand by eating it. With her two pairs of fore legs she draws the strand so taut that when it is fastened it deflects the vertical cables inwardly and this firm line is the topmost horizontal cable which is further strengthened by her spinning several additional webs upon it. She then repairs to a point (*e*) about one-third the distance from one side and attaching another line runs to the side and down it about an equal distance, again eating the slack, drawing the remainder tight and attaching it (*f*). The bottom horizontal cable (*x-y*), is then spun, though generally without stretching and the outer framework is complete.

In a similar manner all of the radiating strands are laid, the first two merely crossing each other from top to bottom and this point of crossing composes the center of the web. As it is desired to have this center in a certain place, generally about one-fourth the distance from the top within the framework, it may be seen what nicety of measuring is necessary; old Euclid himself would have to go some to beat it. From this center the other radiating strands are stretched, as shown, the little engineer going up or down one already in place and carrying another to be fastened at a proportionate distance (as on *g* and at *x*). Each time she returns to the center she passes a fore leg from one radiating strand to another in order to determine the distance between them and finding a space too wide she puts in another strand. The question naturally occurs: Is this reason or mere unthinking instinct?

With the framework finished, and there are some



A common garden spider, *Epeira intersecta,* its web; and the plan of building. The letters indicate the spider's order of procedure. The open spiral at the left is merely temporary bracing, and is removed to make place for the closer weave of the permanent web

apparently unnecessary strands (as at *h*), the spider starts in the center and rapidly lays the first and more open spiral, going round and round and attaching the silk at each radiating strand until she reaches the outer cable. This, however, is merely a bracing or strengthening device, probably to hold the radiating strands firmly until the final, more closely placed and sticky spiral is spun, which is commenced immediately and from the outer edge, the spider eating the first spiral as she works toward the center which is made quite dense. This completes her snare.

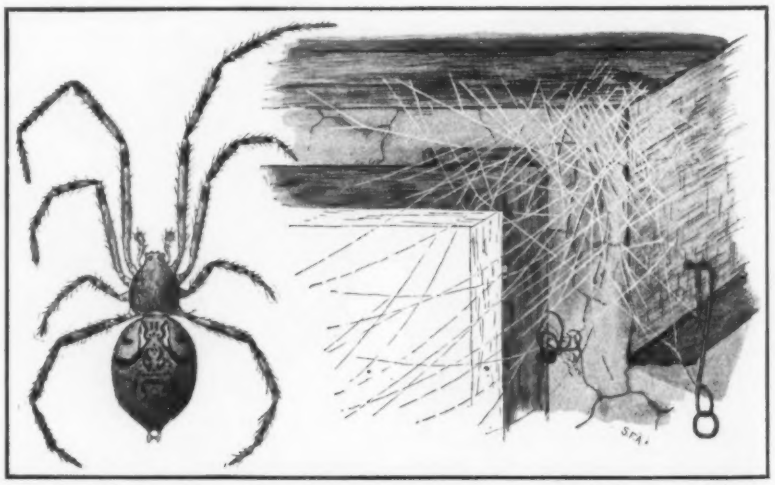
Another spinner that begins to build in much the same manner as the garden web maker is the big black and gold orchard spider, *Argeoepeira diadema*, formerly called and commonly referred to in the popular books as Argiope. But after placing her side cables the construction of her web is like those of most orb weavers, largely reinforced by lateral bracing cables as against the heavy jar of leaping grasshoppers, large zoning beetles and fast-flying bees and moths. Each framing cable and radiating strand is also strengthened by doubling and trebling. Built commonly among tall weeds and grass the supporting strands of Argiope's web are not long and they have such strength that before the snare may be broken the stout grass stalks to which it is attached will often bend or break.

The majority of the orb weavers when beginning their web construction by stretching the topmost cable, practice the common and effective method of kite flying, as often observed and described. This is probably the most highly developed habit to be found among all animals, unless it be the pounding with a stone of the digger wasp.

The spider's kite is nothing more than a very small and loosely spun mass of sticky web, paid out at the extreme end of a long strand and often carried many yards by the breeze. The little kite flier stands upon the leeward side of any object well above the ground, commonly on outer leaves of grass stalk or bush and its abdominal spinnerets are pointed leeward, working rapidly to form the long thread that lengthens several inches each minute. From time to time the body dips downward, clearly to ascertain if the viscid, wind-blown end may have come in contact with leaf or twig beyond the space, for so light are these silken threads that the faintest breeze takes them far out on almost a perfect level. The purpose of this silken kite and its string is to bridge the open space where the spider wishes to erect its snare. Then she runs across the line, strengthening it as she goes with another strand and from this top line she drops to form the vertical anchorages and goes about making her orb.

Who has not while passing through the woods after midsummer felt the sudden tickling stretch of a spider web across the face and with no visible support of this close by? Such is commonly the bridging strands of the spiny-backed woodland spider, *Acrosoma gracile*, a common eastern species, showing many odd variations in color and markings. No web-making spider quite equals this queer-looking creature in engineering skill; the great length of the cross cables, the downward and lateral braces and the rigging are quite superior.

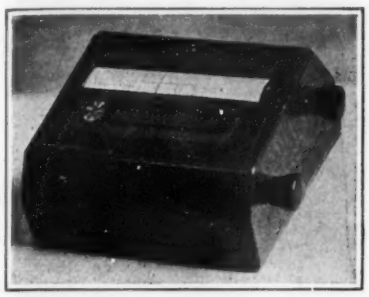
The engineering skill of the orb weavers is in a class by itself. There are many other kinds of spider webs: those of the funnel makers and allied forms and those that build mass webs with strands running in every direction and interlacing in such manner and so closely that they are as fit for entangling a fly as the regular, flat, geometrical webs of the orb weaves. Most common among these mass web builders is the household or cellar spider, *Theridium tepidariorum*, which, though doing its share of good in capturing house flies, gnats and mosquitoes, is hated by the thrifty housekeeper because the snares also gather dust and are spun too rapidly, often in a few hours, in prominent places. There are certain allied bush spiders also which make similar webs with the added characteristic that they sometimes draw the edges of a leaf together by cross lacing to form a hiding place.



The household spider, *Theridium tepidariorum,* and a typical web, with no attempt at order, but stretching in every direction and serving as a very effective trap, alike for flies and for dust

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



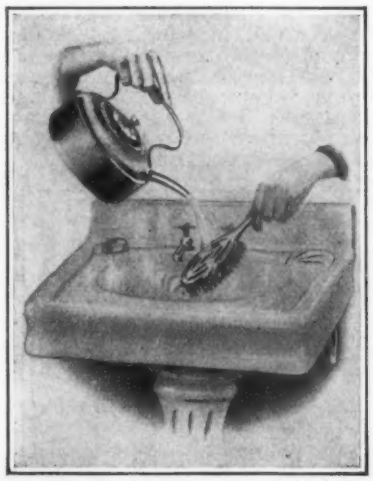
Making it easy to pick up a given station on a three-dial radio set

A Radio Log for Shifting Stations

ONE of the better known of the radio outfits now on the market has three dials; and in order to get a given broadcasting station, there must be a correct setting of each of the three, according to the wave length and other characteristics of the station in question. This involves one of three things: either a long list giving the three settings for each of the stations which one is accustomed to tune in on; a longer memory that will serve the same end; or a fishing expedition every time one seeks a shift of program.

Recognizing that each of these alternatives involves certain inconveniences, an accessory maker offers a clever little device to solve the trouble. His idea apparently is that the list has the fewest inherent objections; but it is awkward to consult, and more awkward to keep in decent shape. So he provides us a means of doing both these things. The list winds on one roller and off another, in the form of a long tape. It carries a printed list of all of the prominent stations, with blank places for the user to insert the little, local ones. He has to learn the correct settings for each station; one having learned them, he sets them down opposite the name—and then he has them. The list can't get dog-eared, can't get shuffled up with other papers and lost, and a given entry can't fail to be found, by turning the knob until it appears, with a minimum of effort.

The printed list, as supplied with the instrument, carries 215 stations; sixty most important ones listed alphabetically first, the remaining 155 following, again alphabetically. Once a station has been logged, it can be picked out and picked up again with the utmost simplicity. This is a large improvement over fishing for a station, or trying to remember when it comes in.

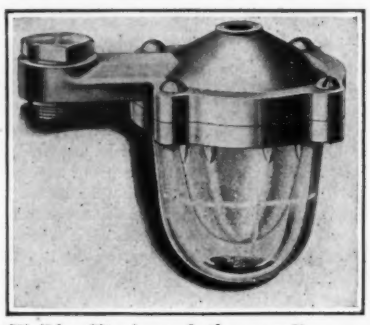


The hair-brush that is washed by simply turning the hot water through its perforated back and wire bristles

Keeping the Dirt Out of the Carburetor

MUCH dirt and foreign matter gets into the gasoline tank of an automobile and causes trouble in the operation of the motor. Part of this dirt is too fine for the strainers in the gasoline pipe to catch it and the result is that the delicate valve of the motor becomes clogged. This new device for filtering the gasoline is attached to the vacuum tank

Just before the gasoline enters the tank or carburetor it passes into a glass



Visible filtering of the gasoline en route to the carburetor

bowl. Suspended in the bowl is a bag of close-textured chamois skin which allows the gasoline to pass but stops the water from passing. Seeping upward through the chamois the gasoline is purified of all the dirt as well as water and the impurities drop into a heavy glass bowl which may be conveniently cleaned out at intervals—and which advertises plainly to the eye when it needs to be cleaned.

Quick-and-Easy Washing for the Hair-Brush

AUTOMOBILE manufacturers and service stations have, perhaps, more than any other class, a large realization of the fact that adjustment and maintenance of anything that goes into the hands of the general public must be made easy, or will be neglected. The car that can't be oiled without a lot of fuss—goes unoiled. The brakes that require a dismantling of half the chassis to adjust—go unadjusted. The fan mounting that can be tinkered with only after the removal of the radiator—stays loose when it gets loose. And by the same token, the hair brush that isn't absurdly easy to wash—goes unwashed. Such, however, is not the case with the sieve-backed, wire-bristled brush illustrated. To borrow a simile from another field, it is washed on the very simple principle of "just add hot water, and serve." There is nothing more to it than that, as the picture shows. So—at least, so the maker hopes—it will get washed at appropriate intervals.

A Bigger, Better Flashlight

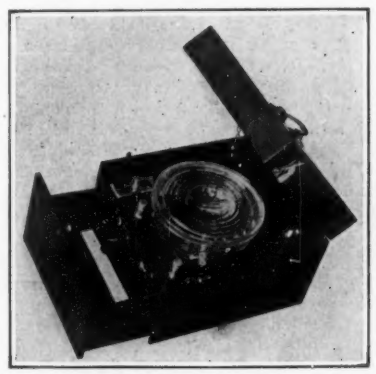
IN this portable electric flash a powerful ray of light is generated by two dry cells carried in an aluminum case. An adjustable focussing arrangement permits a wide spread of light or a ray which, it is claimed, can be thrown an eighth of a mile. A push-button switch is conveniently arranged so that it can be manipulated instantly by the index finger and thumb of the hand which carries it. A wire reinforced glass having a thickness of a quarter of an inch is framed in the swinging door and serves to guard the reflector and bulb from accident.

Directive Radio Beacon

THE Bureau of Standards has developed a new type of radio beacon by the aid of which a ship or airplane equipped with an ordinary receiving set can be guided along a straight course. With the types of radio beacons now in use it is necessary for the ship to use a direction finder and find its position by getting the directions of two beacons whose locations are known. With the new finder the pilot needs to know only where he wants to go.

The new beacon consists of two coil antennae set at an angle of 135 degrees. These are connected alternately to the transmitting set, and one letter of the signal is sent over each antenna. An antenna of this type gives its strongest signal in the plane of the coil and no signal at right angles. Along the line bisecting the angle between the coils the signals from the two antennae are of equal intensity, but as soon as the receiving set is moved to right or left of this line one of the signals becomes noticeably louder than the other.

In a recent test of this device an airplane was flown into Dayton from a point of a hundred miles distant, the pilot relying solely on the beacon for guidance. The signal consisted of the



A uniform plating of gold, needing no buffing, is laid down by this outfit in ten minutes

letters A and T (— ——— — ———) rapidly repeated, the A being sent on one coil and the T on the other. An automatic device is used for sending, and for connecting the receiving set alternately to the two coils.

A Handy Shoe Rack

EVERYBODY knows what a nuisance it is to have shoes on the bottom of a closet and various schemes have been devised to minimize this nuisance. The shoe rack illustrated seems to have solved the problem. The rack can be fastened against any wall or closet door and can accommodate many pairs of shoes. The construction of it is very obvious as a reference to the engraving will show.

This electric flash is so ambitious in range and intensity that it is called a portable lantern

Tests of Precast Walls

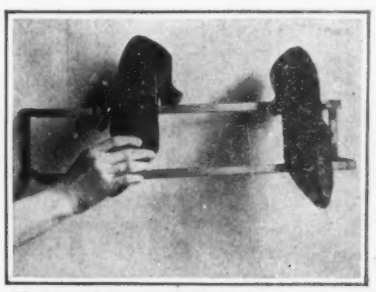
A NEW style of wall known as "Nelstone" was recently tested at the Bureau of Standards, and was found to compare favorably in strength with walls of common brick. It is thought that it could be built more cheaply than brick, as the skill required in laying it is less.

The wall is built up of precast mortar blocks, each of which is 12 inches square and so shaped that when they are laid together horizontal and vertical passages are formed between them. No mortar is used in the construction, but after the wall is built to a certain height these passages are filled with a one-third cement mortar, binding the blocks into a solid mass. Reinforcing bars of appropriate weight and number are first inserted in the passages.

The walls, which were tested in the 10,000,000-pound testing machine, were 6 feet wide and 9 feet high. There were nine of them, in 4-, 6-, and 8-inch thicknesses. The average breaking load was 700 pounds per square inch, and 250 pounds per square inch is considered a safe working load in ordinary building practice.

Gold-Plating by Machine

AN interesting device that has recently been registered for patent is the small gold-plating unit illustrated herewith. It is particularly useful to dentists, jewelers and manufacturers of small accessories. This gold-plater is a portable outfit and very compact. It weighs complete with the two dry cells that supply current, only 8½ pounds. It will deposit a heavy gold veneer on any article, within seven to ten minutes. The gold deposit is of such nature that it is



Neater shoe-storage with the aid of a specially designed rack

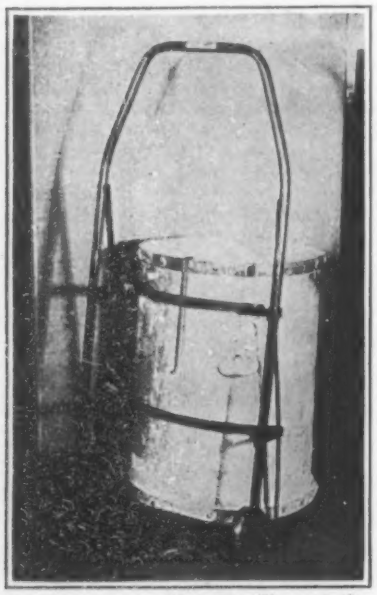
The first American shotgun to utilize the bolt-action principle, so long familiar to users of the rifle

unnecessary to buff the plate in order to polish it, as the article plated receives a bright, lasting polish simply when rubbed dry after being removed from the plating solution. The outfit is sold complete with batteries and plating solution, self-contained in a polished mahogany carrying case.

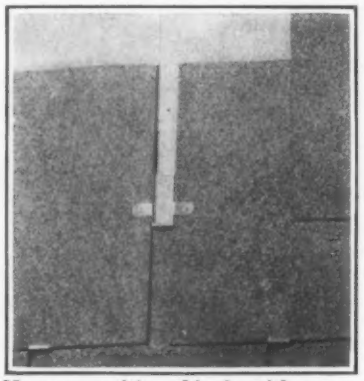
Something New in Shingles

A RECENT invention has its basis in the improvement of roofing from three angles: Overcoming the elements, easy and accurate application, and standardization of roofing lines. It provides automatic and accurate spacing of the shingle in three different directions, namely: accurate space between shingles, accurate weather exposure, accurate break of either ⅓ or ½ as desired, of one course of shingles over the other. It closes the space between shingles, preventing water, snow or dust from being blown up between shingles. It holds the butt of the shingle tight to the roof, preventing shingles from being blown up at the butt, thereby preventing water, snow and dust from being blown up under the shingles; and it holds the shingles tight to the roof, which will cause the shingles, under sun heat, to seal together. It can be applied but the one way, which assures a 100 per cent perfect roof from an application standpoint and eliminates the numerous complaints caused by faulty application.

This device can be applied by the most ignorant carpenter or roofer. No rule or tape is necessary. Lay the first shingle square with the roof eaves, and the device keeps the shingles in absolute alinement; in other words, does the carpenter's or roofer's thinking for him. By using this device a greater weather exposure and a greater spacing between shingles can be obtained on account of the shingles being held down at the butt, and the space between the shingles being made absolutely watertight. By increasing the weather exposure and space between the shingles a perfect shadow line is obtained, which increases the architectural beauty of the roof. Note the photograph carefully for this feature.



For more convenient handling of the garbage can and ash barrel



New composition shingle with many advantages

Water-Level Indicator Plus Filling Device

TO TAKE the place of the usual radiator nozzle cap this combined device makes it easy to fill the radiator with water and as well gives a constant indication of the water level. The float rod is always in view and when it sinks completely down to the level of the circular opening it is time to add more water. The funnel opening at the top is of a shape which makes it easy to pour the water from a pail without spilling and as it is always open there is no necessity of removing it for the addition of water. Anything that might clog the radiator tubes is kept out by means of a screen on the inside of the opening.

A Truck for the Ash Can

THE garbage can and the ash barrel are great household nuisances, particularly in the country where people live in detached houses. The truck shown will save many a trip from the cellar stairs to the curb. An attachment is provided whereby the barrel is held firmly in place while it is being transported.

Bolt Action for the Shotgun

THE rifle has been making much faster strides, of late years, than its companion-in-arms, the shotgun. At least one of the big discrepancies between the two pieces, however, is now eliminated with the offering, by one of the prominent American manufacturers, of a bolt-action shotgun. The bolt action is of the "upturn and pull back" type, simple in its parts and absolutely positive in ejection and extraction. The bolt opens with a powerful leverage against a cam, which insures ejection of the shell. The breech is featured by a wide, roomy opening. The gun is cocked by pulling rearward on the firing pin. A convenient feature is the simplicity of take-down, the gun coming apart in two places only and being separated by the simple unscrewing of a small thumb-screw.

Prolonging the Life of Forging Dies

A SIMPLE but effective method of prolonging the life of shock-resisting tools is described in a recent issue of *Machinery*. This method, briefly described, consists in artificially maintaining the dies or tools, while in use, at a temperature above that resulting from normal operation but below the temperature at which they are hardened and drawn. All previous attempts to accomplish this end had failed until the new method was accidentally discovered by H. Reinhardt of Brooklyn. While in use under the drop-hammer the dies are sustained at an artificial heat of 400 to 450 degrees Fahrenheit, by the use of gas burners. The first set of dies operated in this way produced 8000 forgings, instead of a few hundred permitted by the old method. The field of application of this process is very large.

Portable Extension Lamp

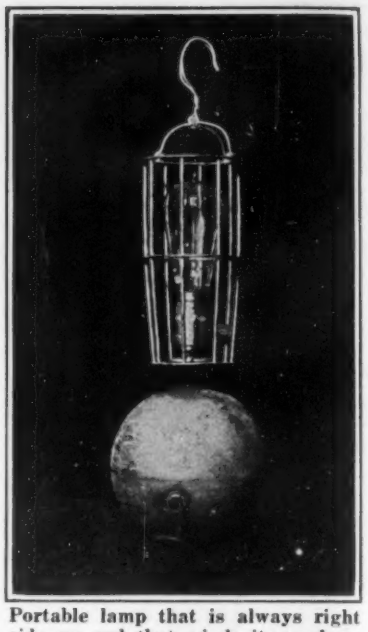
THE purpose of this device is to provide an improved portable lamp commonly referred to as an extension lamp, such as are used in shops or automobile garages or elsewhere, when a light is required in places distinctly remote from the electric plug connections. The particular features of the device are that it will always remain upright or if accidentally keeled over will automatically right itself, due to its weighted bottom. It allows the user to wind up and store within the container all the cord or reinforced electric wire to prevent the cord from becoming kinked, soiled or otherwise mutilated.

In workshops, particularly garages where extension lamps are mostly used,

A handy radiator attachment that discharges two functions

sufficient cord is usually provided with such lamps to allow them to be used in any part of the establishment although the light is most often used conveniently near its plug attachment. The surplus cord is consequently lying loosely in oil, grease and other filth which collects on the floors of such places. With this device the plug is inserted into its socket and the lamp may be carried where it is needed, the wire paying out a sufficient length to cover the distance, thereby preventing the mutilation of the wire. It is so constructed that the lamp may be placed in any convenient position, or hung from a support when desired.

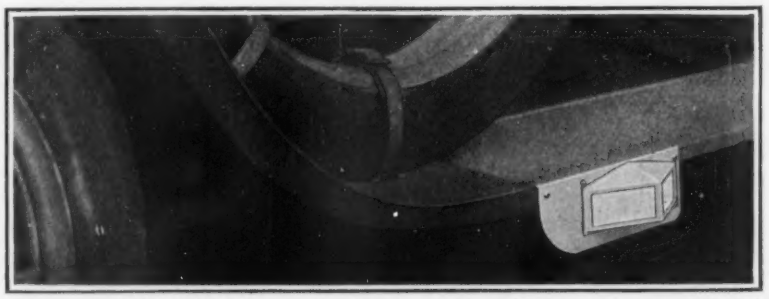
In construction the device consists of a cord container, a hollow spindle rotatably mounted within the container, a convex shaped weight connected with the spindle, the whole rotating on a frictionless bearing, a lamp socket attached to the outer end of the spindle, and a lamp guard enclosing said socket and rigidly connected to the spindle. The cord enters the container, the inner end of said cord enters the hollow spindle and is connected to the socket in the ordinary conventional way. By holding the container in one hand and rotating the lamp guard, the spindle is also being rotated thereby causing the cord to be wound on the spindle within the container.



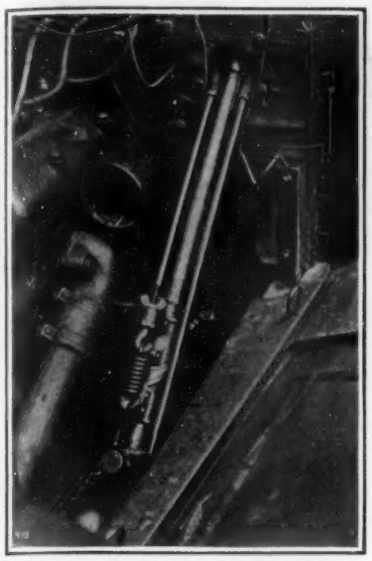
Portable lamp that is always right side up and that winds its cord up out of the way inside the balancing ball

Safer Automobile Lighting

FROM out of California has now come an automobile light that gives triple warning to approaching and passing cars and promises to help reduce the number of accidents on the roads of America. Mounted under the running board, a green light ahead gives instant warning to approaching motorists and a red light warns those coming up from behind. At the same time, a yellow side-light cast downward beside the car shows passing drivers how much clearance they have. Already in California one big insurance company has announced 5 per cent reduction in collision insurance to cars carrying this light.



Three-way light under the running board, which makes for safer passing and overtaking on narrow roads, marking the exact clearance point so the other drive must see it



Spring-controlled steering that gives the little car many of the driving characteristics of its bigger brothers

For Steadier Steering

DRIVERS of a universally popular make of light car may now "flivver" over the country with greatly increased comfort and safety due to a new steering control mechanism that brings all the advantages of worm-gear steering without any sacrifice of flexibility. This steering control device clamps around the steering column and anchors to the car frame. It is controlled by a heavy coiled spring, which holds the front wheels steady over rough roads or bumpy pavements, and even in heavy, fresh gravel. In addition to increasing greatly the ease of steering and control, and the safety of operation of the car, this new device is said to bring big savings on tires and bushings.

Exercise, with Complications

FROM Los Angeles comes the accompanying photograph of a novel exercising device, which may or may not be as practical as it is unusual.

The announced object is to put a kick into the daily setting-up exercises which they do not ordinarily possess. The victim—beg pardon, we mean to say the subject—straps himself firmly into the revolving hammock, by foot, by head and by waist, as illustrated. Then he sets the hammock revolving, and, we judge from the account that comes to us, he is supposed to maintain a sufficient sense of where he is at to indulge in the usual calisthenic motions with his hands—obviously, not with his feet.

Using Up Worn Steel Rails

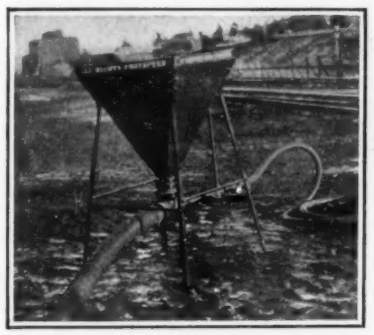
NINETEEN mills in the United States and Canada now are engaged in the conversion of old steel rails into bars and shapes, constituting an important link in the chain of economy and conservation which the iron and steel industry in the United States has been forging. Taking a rail that has passed its usefulness as such, the rail steel industry avoids the wasteful process of remelting, and by reheating and rerolling converts the rail into various sections. In their new forms, rails are given a lease of life that may exceed their original apprenticeship. Broadly speaking, nothing is wasted save the ends where the rails have been drilled, and to paraphrase the slogan of the stockyards, a rail steel mill utilizes every part of an old rail except the wear.

A Fountain Pen for Marking Packing Cases

THIS "fountain pen" is designed to take the place of the old smudgy and messy marking pot and brush which it does very efficiently. The "pen" is made of nickel-plated brass and the "pen point" is made of felt and is so constructed that the flow of ink is regulated by the pressure of the user's hand. The "pen" which is about twelve inches long is supplied with cap to cover the "pen point" when the "pen" is not being used, making a very efficient, compact and clean outfit for marking packing cases and boxes.

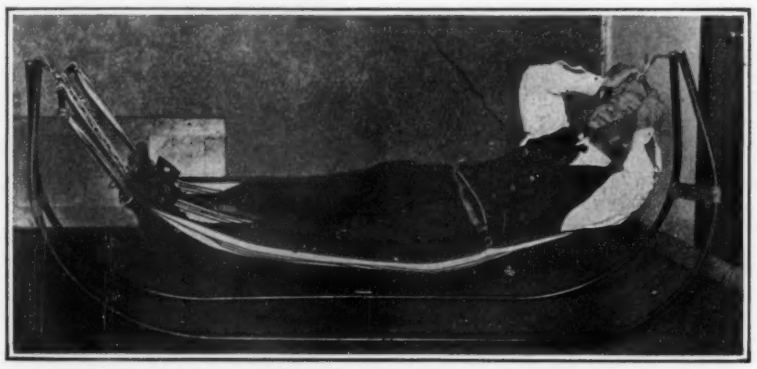
Compressed Air for Feeding Hogs

FEEDING hogs by means of compressed air is one of the latest developments to speed up the handling of stock while being shipped to market. When a trainload of hogs are to be fed, an engine with grain car attached runs along on a track parallel to the stock train. In this grain car is a feeder, which is simply a metal hopper supported at a convenient height on substantial legs. An air hose extends to this hopper from

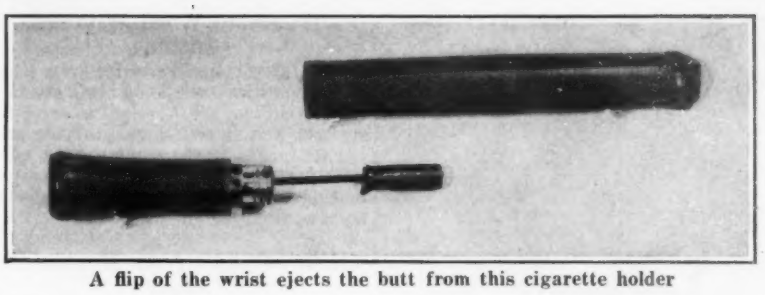


Apparatus for feeding hogs with the aid of a compressed-air line

the engine and drives the corn or other grain through a feed hose to the cars. With this outfit, feed can be supplied to double-deck cars at the rate of ten bushels every two minutes. Grain can also be transferred with this equipment from bad-order cars at a decided saving over ordinary methods in use, so we are assured by the inventor.



Adding the punch of a revolving hammock to the daily setting-up exercises of the jaded business man



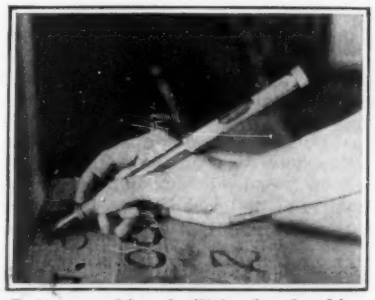
A flip of the wrist ejects the butt from this cigarette holder

A Self-ejecting Cigarette Holder

ONE of the drawbacks concerned with the use of a cigarette holder is that of fishing out the butt after the smoke is finished. The cigarette burns down to the holder and one's fingernails must then become fishhooks if the little end is not to remain where it is no longer wanted.

Now comes a Newark, N. J., manufacturer with a cigarette holder having a little weight which is free to move within certain limits in the passage that conducts the smoke, and to this weight is attached a short wire ending in a right-angled turn which does not show in the illustration. When the smoke is ended, all that is necessary to do is to give the holder a smart little snap and the weight does the rest—the butt flies out, with a soul-satisfying click.

A number of other features make this holder worthy of notice. The bore is made right—it does not mash the cigarette up, nor does it constrict it so that the draft is all but shut off. In addition, the holder has a large cooling chamber which extends well towards the mouth end, and this condenses the irritating oils from the tobacco. The tip is threaded, so that the weight which ejects the butt may be exposed by unscrewing it, thus permitting it to be wiped clean or washed out with alcohol.



Better marking facilities for the shipping clerk

Tar-Treated Concrete Resists Salt Action

INVESTIGATIONS carried on by the Bureau of Public Roads on the waterproofing properties of water gas tar have indicated the possibility of utilizing this material as a means for protecting concrete from the action of saline solutions. It has been found that crude water gas tar having a specific viscosity of from 6 to 12 will enter freely, under atmospheric pressure, into dense concrete and mortar and is largely absorbed by the hydrated cement. Cement drain tile so treated have shown no signs of disintegration under test.

Alabastine

YEARS ago a young Englishman settled in a sparsely populated valley of western Michigan on the banks of the Grand River. One day in walking over a newly acquired bit of land he noticed an outcropping of a familiar crystalline substance. He hit it in an inquisitive way with his walking stick and the softness of the material reminded him of a similar experience in Italy. He had found alabaster rock, from which alabastine is made.

Beds of it underlie and overlie many acres in Michigan. Some lies on the surface and extends downward a score of feet and open quarries are employed in the work of recovering it. Again, the rock is closely guarded by over-lying soil and lies many feet beneath the surface, so that tunneling is essential.

The tearing loose of the substance is accomplished by blasting, which breaks the rock up into large chunks. These chunks each as big as a pig's head, are carried to the crushing mill where they are ground into small pieces, these to be passed between immense stones and ground to still further fineness. Now the crystals are ready to be carried to the kettles for the purpose of calcining.

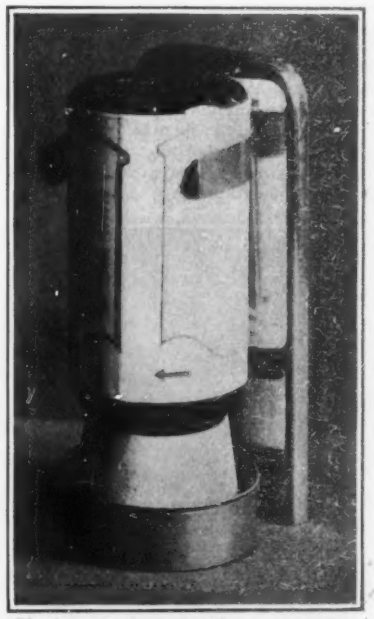
The fine crystals are thrown into the kettles, fire applied beneath and the innate moisture of the rock is, when subjected to the intense heat, sufficient to change the mixture into a seething mass or fluid; the boiling occurs at 380 degrees.

The material is now ready for the addition of the coloring pigments. These pigments are crude in form and coarse in shape; they, too, are ground and reground, tested and refined.

Large mechanical arms stir and mix all together, throwing the powdered mass hither and thither until the color particles and white particles are thoroughly blended to form alabastine.

Making the Closet Moth-Proof

ALTHOUGH authorities upon the subject impress upon us the difficulty of getting rid of moths, the experience of the housewife indicates that there are certain atmospheres in which these pests will not remain; and the moth ball, the cedar chest and the sulfur candle are simply familiar and rather homely means



Chemical disinfecting apparatus which is said to be particularly efficacious against moth

Revolving knife that shaves the tiniest slice off a wooden piece without crushing it

for providing such atmospheres. Rather more elaborate, but correspondingly more effective, if we may believe the claims, is the device illustrated. The cylindrical container drips a fluid down on to the cake below, and the result is a chemical combination in which the moth cannot live. Refills, both for the upper and for the lower member, may be purchased. In addition to its specific action against moth, the product of the combination between solid and liquid is a general disinfectant of value.

Handy Gadgets for the Amateur Gardener

ALL those who have gardens know the fatigue pursuant to kneeling when any operation is required near the surface of the ground. From England we have a kneeling mat which seems to solve the problem very effectually. It is made of rush or straw and the bottom is water-proofed so that the damp and dew will not strike through. These pads are very extensively used in England.

Another source of nuisance to the person who attempts to make two roses grow where but one flourished before is the very fugitive character of his tools and appliances. Shears and trowel, twine and wire, are always somewhere else than where he wants them and where he thought he had put them. A remedy for this is offered in the basket illustrated. It will still, perhaps, require a certain amount of strength of mind to put the trowel and the clippers back in the basket after each episode with them; but the wire and the string, at least, seem fixed. And then, there is the added convenience of keeping them together overnight, finding them all in the same place in the morning, and having a handy means of conveying them all to the seat of action.

Trimming Wood Without Crushing

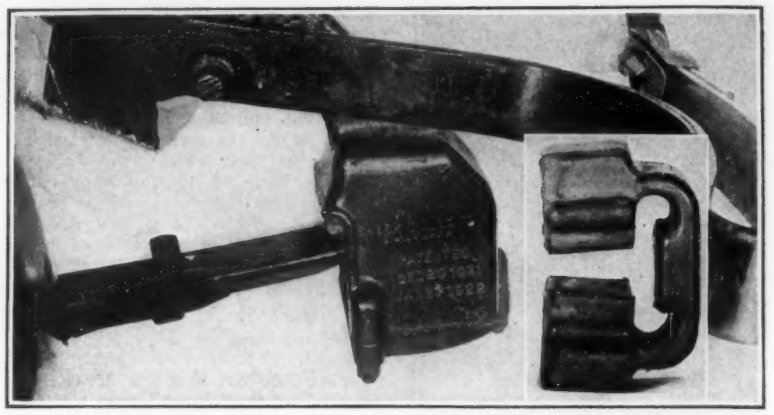
WHEN this new revolving knife trimmer is used the wood is not crushed but is cut so as to leave a perfectly straight and smooth edge. Sixteen and a half inches is the total cutting edge of the knife and by setting guides on the machine any angle up to 45 degrees may be cut.

Airship Ballast from Engine Exhaust

PLACING a bank of pipes above and in front of the engines of an airship is a device developed at the Bureau of Standards for cooling the exhaust gases before release and condensing for use as ballast the water they contain. Without this device an airship loses weight in flight because of the burning up of gasoline by the engines. This makes it necessary to valve some of the lifting gas to keep the ship in equilibrium, and if helium is being used several dollars worth of it will be thus wasted for every gallon of gasoline burned.

Water is formed in the engine exhaust by the combustion of the hydrogen in the gasoline. The hydrogen takes up eight times its weight of oxygen from the air, and the water condensed is approximately equal to the weight of the gasoline. Under exceptionally favorable conditions 130 pounds of water have been obtained from 100 pounds of gasoline, while under worse conditions the water yield has run as low as 70 pounds.

The device consists essentially of over 3000 feet of one inch aluminum tubing about 0.016 inch thick. It weighs about 400 pounds and will handle the exhaust from two 150-horsepower engines.

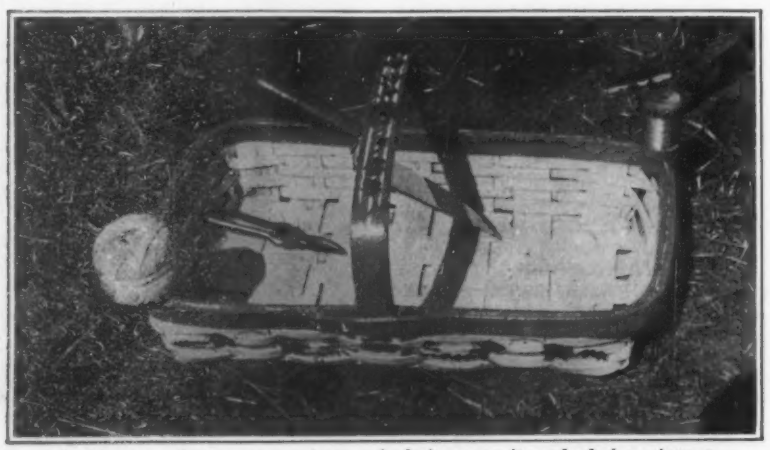


The rubber spring shackle, assembled and (insert) in detail

Keeping the gardener's knees clean and comfortable

Tests on Kaplan Turbines

A NEW type of water turbine designed by Professor Kaplan of Brünn, Czecho-Slovakia, for use in connection with small heads, has been finding of late increasing attention. In order to get a definite idea of its merits Swedish authorities recently tested one minor unit with a rotor 950 mms. in diameter designed for a head of one meter. These tests made at the Lilla Edet testing station of the Water Falls Department, showed the turbine to develop 18.9 horsepower with 147 r.p.m., the efficiency being 87 per cent as a maximum and 78 per cent with one-quarter load, which is a remarkably good performance. A larger Kaplan turbine set has been designed for a maximum output of 11,200 horsepower under a head of 6.5 meters for direct coupling to an electric generator, the number of turns being 62.5 r.p.m. Its rotor is upwards of 5.5 meters in diameter and weighs about 62 tons. The rotating blades of the rotor are controlled indirectly by a regulator and a servo-motor fitted into its hub. Former installations of Kaplan turbines in Swedish power plants comprise one unit of 100 horsepower under a head of 3.5 meters installed near Forsvik, one of 400 horsepower, 4.2 meters at the Gävle Electricity Works and one of 480 horsepower, 6 meters, at the Hörle Works.



Another gardening convenience of obvious merit and obvious intent

The Rubber Shock Insulator

IN place of the orthodox metal shackles and spring bolt construction, a New York manufacturer has substituted rubber spring shackles. As shown in the illustration, the method of adding springing power to a car or truck consists in imbedding the ends of the spring in rubber blocks held fast in metal housings in such a manner that the resilient rubber is forced to take up the entire longitudinal stress brought about by the weight of the car plus the springing effect. These rubber blocks are not visible from the outside, so one was separately photographed and this photograph was let into the engraving in a position as close as it is possible to show it to the actual position it occupies in the housing shown in the general view.

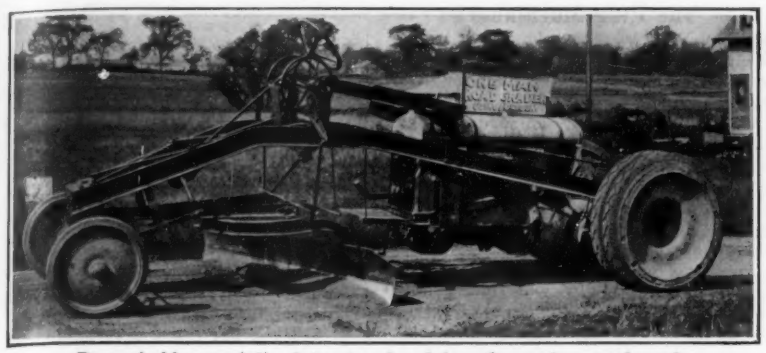
The rubber shock insulator or spring shackle has, according to the claims of its manufacturers, a number of advantages over the common shackle. It requires no lubrication. Since there is no friction between the surfaces it permits of no wear, rattle or looseness. It gives a cushioned shock rather than a banging, metal-against-metal shock. By cutting out vibration it reduces the liability of crystallization of springs and frame. In addition there are numerous less important advantages.

In the case of one leading manufacturer of heavy trucks, the rubber spring shackle has made good to the extent of running at least 50,000 miles on a five-ton truck without appreciable wear.

A Novel Foil for the Pay-roll Bandit

SOMETHING a little easier to install and operate than the armor-plated, bandit-proof car is now offered as a foil to pay-roll bandits. It consists of a trick satchel in which the money is to be carried. When attacked, the messenger presses a button in the handle of his grip, which sets off a number of concealed smoke-bombs, held in the bottom of the grip. These will burn for twelve minutes, throwing out a heavy smoke the while. Not only is this sufficient indication to the whole world that something wrong is taking place, but in the event that the bandits actually get away with the contents of the satchel after all this, they will find the bills so discolored by exposure to the chemicals that they will be unable to pass them. The only way to get the value out of them will lie through redemption, and your Uncle Samuel is expected to display a certain mild curiosity, when they are offered for this purpose, as to how they got that way.

The smoke-screen satchel that is designed to puzzle the highwayman



Remarkably specialized tractor for doing the spring road-work

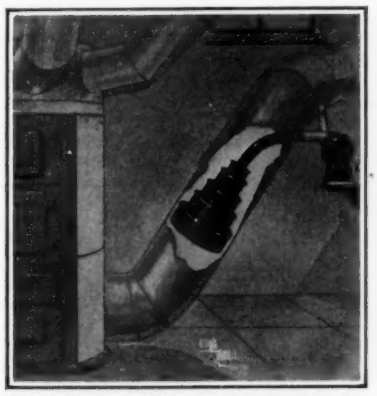
Educating the Hot-Air Furnace

BY applying some mechanical means to force the air through the system of ducts and flues in a more positive manner than is possible by depending upon the difference in the weight of two columns of air at different temperatures it is claimed that many of the uncertain factors in furnace installations can be eliminated, and the operating expense reduced. This circulation can of course be brought about by means of a power blower. But the main objection to the fan or blower has been the first cost and high operating cost. This has been due to the fact that almost invariably the blower has handled all the air that passes over the furnace, all the time, regardless of weather conditions. Further, when shut down, it usually became such an obstruction to the flow of air that the furnace failed to do even as well as it ordinarily would do, when operating simply on a basis of differential gravity circulation. The answer to all these woes is to be seen in the illustration on this page. This circulator consists of a small motor driven blower and a series of sheet metal rings set concentrically, located in the return air pipe to the furnace. The blower is connected to the device by means of a small pipe. With the blower in operation the current of air expands in the device and induces an additional flow of air through the spaces between the rings.

Exit the Six-Horse Team

NOT so long ago those of us who lived in the country knew spring had arrived when we heard the call, "Hey, Skinny, c'mon over—they's a road scraper with six horses, n'everything!" Six horses! Sometimes it took eight. Then there had to be a man to drive, and no every-day driver could handle six horses. It required a real teamster to keep the whole six "ribbons" well in hand. There had to be another man to manage the scraper blade, and that man had to be proud of his job. He thought nobody else in the whole world could

Grinding with a belt of abrasive surface



Forced circulation for the hot-air heating system

do as well—in fact, it would take two ordinary men to do it at all.

In this year 1924, one man plus four cylinders does the whole thing. That is because it is easier to drive a tractor than even a single horse; while the work the blade man used to do is easy enough, for there has to be no coordination of two minds—the man who drives the modern scraper also drives the tractor. The number of modifications to which a well-known make of tractor has been put is a revelation. Here is one equipped with broad rubber tires for good traction and mounted on, or rather in a road scraper. The forward wheels have been subtracted (pun unintentional) while the gearshift lever and clutch lever have been extended to the platform on which the driver stands and steers, at the same time raising and lowering the scraper blade. Here are one man and about three gallons of kerosene or "gas" per hour, doing what used to take six horses and two men.

A Truck Tire That Breathes

A NEW motor truck tire designed as a semi-pneumatic, anti-skid tire has a number of cellular openings. As the tire comes in contact with the road the openings gradually close and as it passes the point of contact gradually open again, and this breathing feature of the cellular openings results in instantaneous cooling. The radial holes form a gripping suction on slippery streets. The holes in the tread allow free displacement of rubber and serve a cooling purpose similar to a radiator on a car.

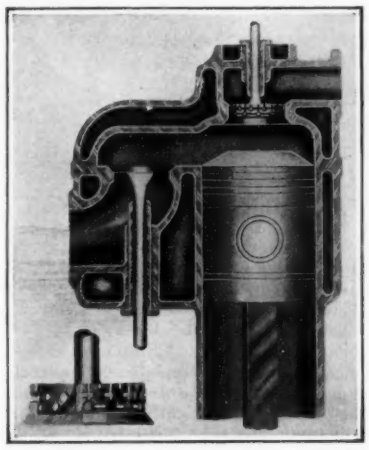
The Abrasive Band Grinder

GRINDING may be done on abrasive wheels, but surfaces produced in this manner are not flat, no matter how great the diameter of the wheel. But the band grinder is flat, and it therefore grinds to a true flat surface. Such a grinder as the one illustrated on this page has a belt four inches wide. In addition to the tension given the belt by a spring which tightens the idler, there is a working table which is true and level. This table is five inches wide, an inch wider than the band. This permits the band to be moved at will from side to side, putting the part of the abrasive surface in the position desired for the work being done. The abrasive band itself may be quickly changed while the pulleys are in motion, permitting the substitution of the correct grit desired for the work in hand.

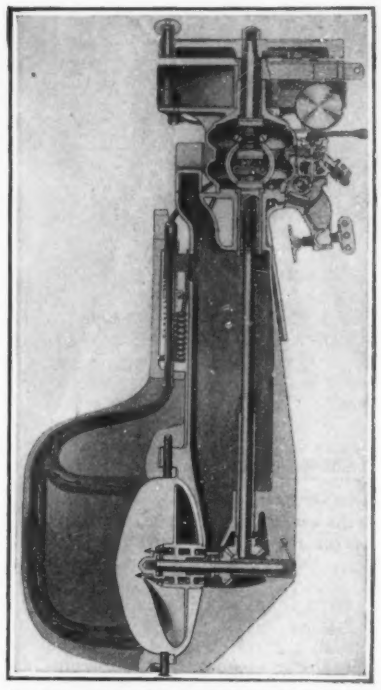
A machine of this sort is highly valuable in any metal working shop, in fact in almost any sort of shop where use is made of brass, bone, hard rubber, fiber, aluminum, celluloid, bakelite, copper and steel. Using a coarse grit a beautiful straight grain finish is obtained, and since the work may be held steady against the guide, the grain is geometrically true.

Making the Intake Valve Do More Work

AMONG the multitude of inventions designed to secure more efficient mixture of the intake gases in the automobile engine, the one we illustrate, by R. P. Grieve of Holdenville, Okla., seems to possess elements of distinction. It is an intake valve with an annular rim back of the beveled seat, and with grooves and perforations through which the gasoline-air mixture must pass en route to the cylinder. The inventor calls his device a recarbureter, and refers to its work as the remixing of the fuel gases. It is obvious that turbulence is increased by his design, and late researches impress upon us the importance of that feature of manifold design. The inventor pictures his device as resulting in a uniform mixture, entering each cylinder at all speeds, with the gasoline broken into the finest particles possible, and perfectly mixed with air.



Intake valve of special design intended to improve carburetion; the valve is shown enlarged in the insert at the lower left



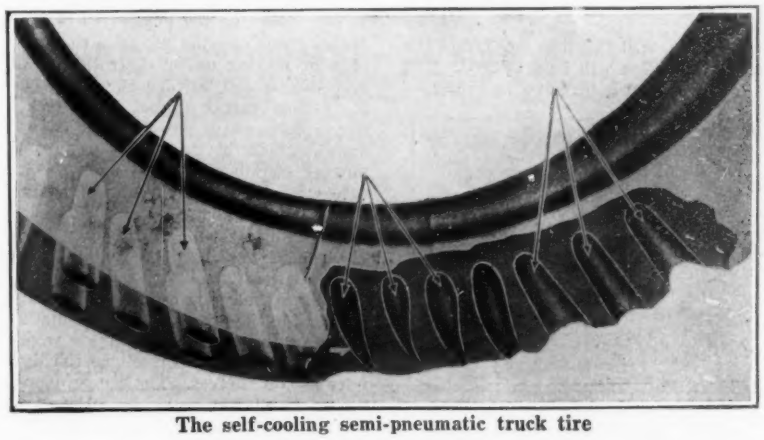
Small outboard motor that substitutes a scoop-up and suck-out system for the old mechanical water-circulating pump of the motorboat cooling system

The Propeller Pump

ANYONE who has run a motorboat having a mechanical pump for the water-cooling circulation knows what a fruitful source of cursing they can become. One finds one's self continually looking over the side to see whether the intermittent jets of water that indicate that nothing has gone wrong with the pump are still issuing from the discharge pipe. But in a late model of a small outboard motor—one of the kind you carry around in an overgrown suitcase and clamp on the stern transom of the old fishing boat—this sort of trouble is obviated by the invention of Ole Evinrude, whose new method of forcing the cooling water to circulate might be said to involve no moving parts at all—unless you count the propeller and the boat, both of which were going anyway long before the pump was on the job. In this motor, which is the product of a Milwaukee, Wis., manufacturer, the circulation is maintained by a scoop and syphon.

The rudder which is a part of this compact power unit is not an ordinary thin piece of metal, but has sufficient thickness to provide for two openings of channels which are so contained in the rudder and rudder yoke that a casual observer would not notice the use to which these parts were being put.

These openings are just aft of the propeller and are so arranged that the



The self-cooling semi-pneumatic truck tire

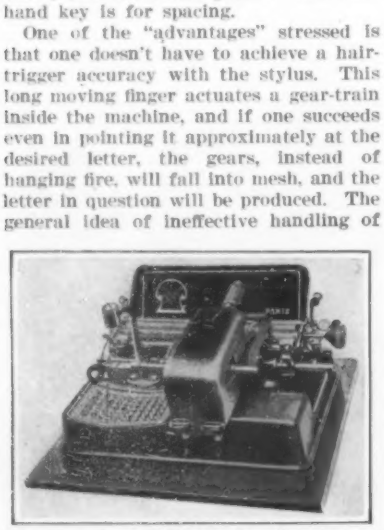
Double-wall concrete construction, with air space between, that gives better control than usual over the indoor weather

pressure from both blades of the wheel is utilized. The motion of the craft through the water assists somewhat in maintaining a concentrated pressure, although the pump functions perfectly, even when the boat is made fast to the wharf. The water is forced up through an inlet pipe and this pipe also acts as a fulcrum upon which the rudder yoke swivels. Water is carried to the water jackets of two "double opposed" cylinders, cools them and descends from each cylinder through outlet tubes approximately 50 inches in length. Part of these tubes are in a coil formation, which permits water to be discharged above the water line so that it is visible to the operator. Enough pressure is developed at high speed to lift the water to a height of about six feet, while the cylinders are only about two feet or less above the water level.

A Typewriter, or a Toy?

AMONG the curious inventions of the month, a high ranking certainly is earned by the French keyless typewriter illustrated. The function of the ordinary key is discharged by the stylus that is seen suspended over the keyboard. One points this at the desired character, whereupon a "simple compensating mechanism" (to quote our informant) under the hood causes the type cylinder to shift so that the letter at which the accusing finger points is brought directly over the point on the paper where the next letter must strike. Then, in a separate motion, the operator depresses the right-hand key at the front of the machine, and the letter prints. The left-hand key is for spacing.

One of the "advantages" stressed is that one doesn't have to achieve a hair-trigger accuracy with the stylus. This long moving finger actuates a gear-train inside the machine, and if one succeeds even in pointing it approximately at the desired letter, the gears, instead of hanging fire, will fall into mesh, and the letter in question will be produced. The general idea of ineffective handling of the machine which one gets from this argument is supported when one learns further that a beginner has less difficulty on this apparatus than on a type-bar machine of the usual sort. We must say that the idea of the innocent beginner, patiently swinging his stylus with one hand and punching his key with the other, appeals to our sense of humor. It is with a somewhat different reaction, however, that we view the claim of a speed running up to 300 characters per minute; and when we note that the letters are not arranged under the stylus as they are on the universal typewriter keyboard, we wonder just what role this amusing toy is supposed to play in relieving its user from permanent classification in the ranks of "beginners."



A French substitute for the typewriter, that works without keys

The Thermos-Bottle House

OPERATING on the double-wall principle of a thermos bottle, a San Jose, California, inventor has developed a new type of concrete construction which tends to keep a house at a comfortable temperature despite outside weather conditions. The walls are made of two vertical sides with an air space between, bonded together by steel cross ties. Building is done with oblong units of solid concrete 8 by 16 inches, of varying thickness from 2½ to 4 inches, depending on the strength needed, having tongue-and-groove edges. When these are laid up edgewise and grouted together with neat cement they form two separate monolithic walls amply trussed together by the cross-ties. At corners of the house the units interlock in such manner that the hollow space inside the wall remains continuous, for the success of the double-wall construction depends on having no concrete connection between the outside and inside to conduct moisture through by capillary attraction. Thickness of the complete wall may be made whatever is desired, and the finished result is practically a house within a house, effectively insulated from the out-of-doors by the dead air space within the walls.

Unique Powder Magazine

IN order to save the expense of a brick storage place for explosives the New Jersey Zinc Company hit upon the simple idea of mining under their tailing pile and storing the powder there. Accordingly they ran a tunnel eight feet by five a distance of seventy feet into the dump, which in this case brought the powder chamber 25 feet below the surface where it was comparatively unable to do great damage. In order to keep the dynamite from freezing in winter a method of heating had to be devised, and this method must be a safe one, of course. An electric heater was installed just inside the opening of the tunnel and hot air was conducted through a wooden duct into the chamber where the dynamite lay on shelves. The temperature is automatically controlled by a thermostat in the magazine.

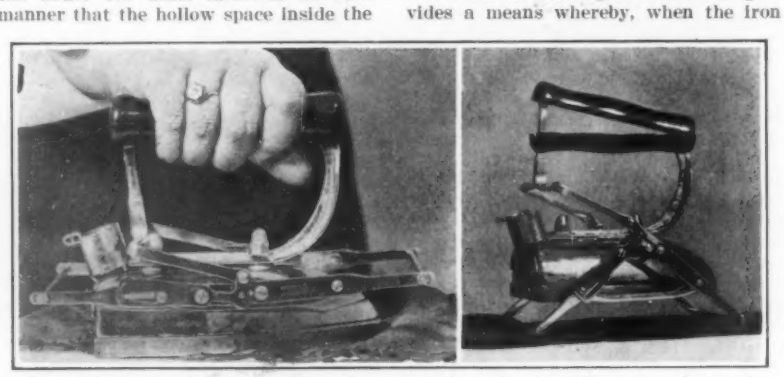
The Ring Machine

THE making of a complete ring, truly circular in form, from bars previously cut to length, is rather difficult. Usually the ends remain straight for a short distance and have to be finished up by hand, with loss of accuracy. The machine illustrated eliminates this difficulty, forming a perfect ring, from end to end, out of straight bar stock. The material is fed into the machine from left to right, the end being firmly gripped between the two centrally located rollers, through an eccentric lever on the reverse side of the machine (the handle projects at the left of the picture). At the bottom of the machine are two adjustable shoes which extend upward between the first and second, and the second and third, rollers. These shoes are accurately machined to fit the contour of the stock, and they assist in guiding and shaping the bar as it is drawn forward between the rolls. They have a slight adjustment to take care of any small variation that may be desired in the diameter of the ring to be formed, to allow for the spring of the metal, etc. The machine is hand operated but can easily be arranged for a belt drive. With hand operation, the speed of ring formation is about 10 to 15 feet per minute; with power drive this would be materially increased.

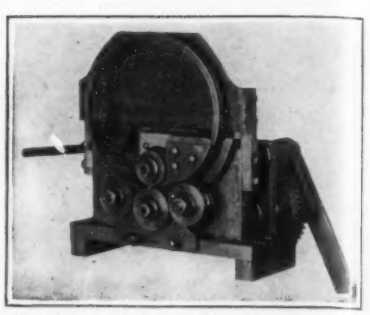
Automatic Legs for the Electric Iron

THIS support for electric or gas pressing irons eliminates the cumbersome and inconvenient rests or stands hitherto used for resting the iron. It provides a means whereby, when the iron is not in active use, it "stands" on mechanically operated legs which are controlled and brought into supporting or non-supporting position automatically.

The invention comprises a wooden handle made in two sections, the lower of which is rigidly attached to a specially shaped metal handle frame and the upper pivoted to the front end thereof and capable of an up-and-down movement. To the free end of the upper section is pivoted a metal arm which, passing through a slot in the lower section, branches out on both sides of the iron and is pivoted at its lower ends to a point which controls the movements of the legs, which are pivoted on each side of the iron. Thus, when the iron is "standing" on its legs (the upper section of the handle being then extended or "open"), as soon as the handle is grasped said upper section is automatically compressed downward upon the stationary lower section, thereby forming a normally complete handle while being held in the hand, as when in active use. This movement in the handle is simultaneously transmitted to the legs through the controlling arm, causing said legs to snap into non-supporting position, where they remain, sufficiently above the usable surface as not to interfere with the pressing operations. To rest the iron, simply raising it by the under surface of its handle, as usual, releases the upper section thereof from compression, whereupon the legs now snap into supporting position and are also automatically and securely locked therein. This allows the iron to be shifted about on its legs, if desired, without collapsing. However, when the iron is again taken in hand to be used, the legs instantly resume their non-supporting position, as before. The rest can be built either on the iron itself (as in the photographs), or as an attachment thereto, in which case it is built entirely in conjunction with a handle capable of attachment by substituting it for the regular handle.



Rest for the iron that is ready when wanted, and out of the way when not



Hand-operated outfit for forming straight bar stock into rings

Rubber for Road-Surfaces

EXPERIMENTS are being carried out in Ceylon by the Colombo municipality in the use of rubber as a road-surface dressing. The present test, according to the *British Trade Journal*, is the hardest to which the new solution has been put. The solution is made from pure bark and scrap rubber. The method of laying is similar to that employed with tar and asphalt preparations, it being heated until liquid, and then spread on the road with brooms. Fine gravel is then sprinkled over the solution and a steam roller binds the two. It is claimed that though the cost of the liquid rubber is higher than tar, it is found to last twice as long.

Waterwheel or Dater?

A DATER having a year-date wheel resembling a windmill is the product of a Springfield, Mass., manufacturer. This unique device has ten years on the wheel and is otherwise built to last. An attachment on the side of the dater locks the alinement positively and accurately. The many-armed wheels, of which there are four—respectively for month, two date digits and year—are of solid rubber, molded in one piece. The dater permits of unusually accurate adjustment.

A circular date-stamp of novel design

The Heavens in July, 1924

The Amateur Observer and the Role Which He Can Play in the Science

By Professor Henry Norris Russell, Ph.D.

EVEN in this day of great observatories and huge telescopes, the amateur astronomer may make observations of permanent scientific value. If he is fortunate enough to possess a telescope—even a small one—he may, for example, observe the brightness of variable stars. The admirable work which has been done by the Association of Variable Star Observers in this country, and by a similar organization in England, has already been described in these columns. Or, if the telescope is a bit bigger, he may hunt for comets. This takes more patience; but if successful, as it is sure to be sooner or later in the hands of a competent worker, secures him a permanent place in scientific literature, for the comet will be known by the name of its discoverer.

During the years of the war and just after, the number of comets discovered fell off seriously. Things appear to be improving now, but there is still "good hunting" for anyone who cares to try in earnest. For example, last autumn d'Arrest's periodic comet—which returns at intervals of about 6⅔ years—was due, and for some time failed of detection. It was finally picked up, quite unexpectedly, by Mr. Reed of Cape Town, who was hunting for comets without special reference to this one. Later it appeared that it had been seen a month earlier by Mr. Mellish in Illinois, who made a rough record of its position but did not, as Mr. Reed did, notify the world in time to set others searching for it.

Within the present month a cablegram from the Central Bureau for Astronomical Telegrams, at Copenhagen, has announced the discovery of another comet, by "Reid," in the southern constellation Fornax. As this region of the sky was then and is now nearly south of the sun, and observable only from points in our southern hemisphere, it is probable that the discoverer is again our South African friend, whose name has suffered a not improbable hazard of transmission. An orbit computed for the present comet indicates that it has already begun to recede from the sun, and was never less than 160 million miles from the latter, and even farther from the earth. It may remain in telescopic view for some time, but stands no chance of being conspicuous.

The Amateur and Meteors

But even the man without any telescope at all can be of real use to science. For example, he can observe meteors, or shooting-stars. Except in the rare instances when a meteor is caught by accident in some part of its path, by the astronomer's camera, we must rely entirely upon visual observations; and, after a reasonable amount of practice, it is possible to make up good records of these fugitive sparks of light, drawing their tracks in upon charts prepared in advance, in their correct positions among the stars, while the impression is fresh in the memory.

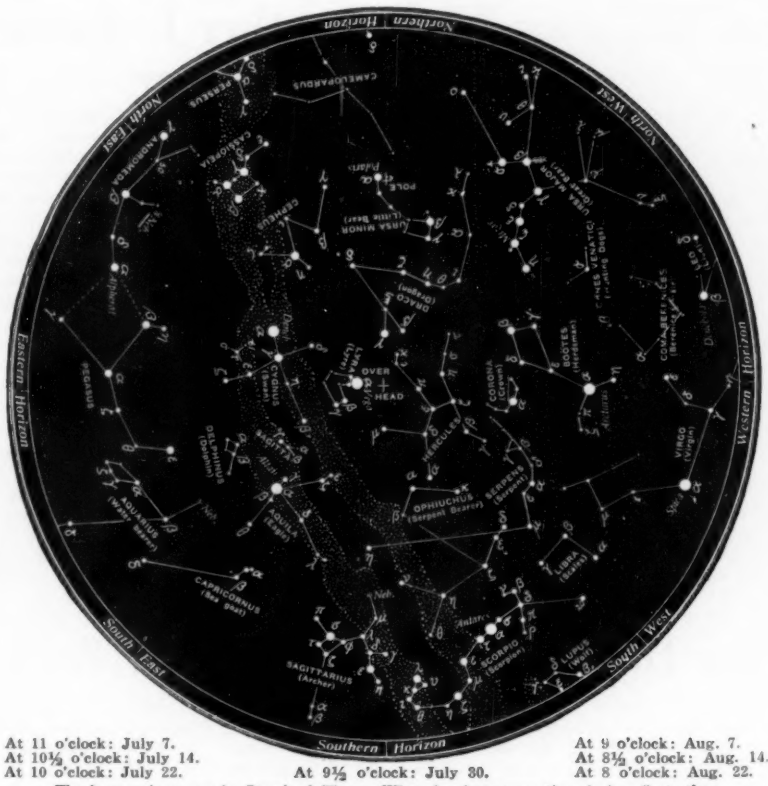
A single observer can make excellent records of the number of meteors seen per hour, their tracks, and when showers occur the point from which these tracks seem to radiate—from which observation the real orbit can be calculated which was followed by the meteors before they entered our atmosphere. If two observers, a few miles apart, were to make such observations at the same hours, recording the times at which the meteors appeared, they would probably secure a goodly number of "doubly observed" meteors, for each of which the distance from the observers and the height above the earth's surface could be calculated—giving valuable knowledge, not otherwise accessible, about the extreme upper layers of the atmosphere.

Knowledge of the velocity of the meteors would be still more valuable, as, if sufficiently accurate, it would tell us whether the meteors had been moving on a small orbit, like an asteroid; on a large one, practically parabolic, like a comet; or perhaps had been moving even faster and had entered our system from interstellar space. But to time an unexpected phenomenon to a fraction of a second is not easy. The late Professor Young—one of the outstanding figures of the earlier generation of astronomers—told the writer once that, whenever he saw a meteor, he began saying, *sotto voce*, "Maria had a little lamb, its fleece was white as snow, and everywhere Maria went, the lamb was sure to go." To repeat that bit of doggerel at his accustomed speed took him 6½ seconds, as determined by practice before the clock. It had to be Maria so that the syllables should go along quite evenly! Grotesque as it sounds, this simple scheme affords an excellent means of timing a small interval—provided excitement does not alter the observer's rate of speaking!

Another Instance

Still another example of the utility of amateur astronomers is found in an interesting paper recently published by Mr. Willard Fisher, upon the brightness of the totally eclipsed moon. It is known to everyone that the faint reddish light that dimly illuminates the moon while the latter is plunged in the earth's shadow comes from the sun, having been bent into the shadow by refraction in the earth's atmosphere. The clearer the air above that part of the world where the rays pass, the more light will reach the moon, and the brighter it will appear. From a study of the records of 68 lunar eclipses between 1860 and the present, Mr. Fisher confirms the opinion previously expressed by different investigators, to the effect that for a year or two after great volcanic eruptions—like that of Katmai in 1911—the eclipsed moon is unusually dark, doubtless because the upper atmosphere is hazy with volcanic dust. But an unexpected discovery is that the eclipsed moon is, on the average, a great deal darker when those rays that reach it have passed over the northern regions of the earth than in cases where the moon is south of the center of the shadow, so that the sun's rays have passed near the south pole. The only obvious explanation for this is to suppose that, on the average, the upper air in the Arctic regions is more obscured by clouds and haze than in the Antarctic. It may be some time before we have direct weather reports sufficient either to confirm or to disprove this explanation.

The descriptions on which Mr. Fisher bases his estimates of the brightness of the eclipsed moon were of the roughest sort, and further observations, made with all possible care, would be valuable.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.
At 9½ o'clock: July 30.
At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

The Heavens

Turning to our accustomed view of the skies, we find Vega almost overhead. Well down in the west is Arcturus, with Corona and Hercules above. Regulus and Spica are near setting, as is also the planet Saturn. Scorpio and Sagittarius shine in the south, Jupiter blazes in the southwest, and Mars low in the southeast. Pegasus is low in the east, and Cassiopeia in the northeast. Ursa Minor and Draco are high in the north, and Ursa Major is sinking in the northwest.

The Planets

Mercury is in conjunction with the sun on the 5th, and is invisible until the latter part of the month, when he sets at 8 P. M. or a little later (standard time, as throughout the present text) and is easy to see.

Venus is also in conjunction with the sun on the 1st, and soon reappears as a morning star, becoming very conspicuous in the dawn, as she has been in the dusk. She rises at 2:30 A. M. on the 31st.

Mars is approaching opposition, and growing larger and brighter day by day. By the end of the month he is only 38 million miles away, and is brighter than Jupiter at his best; so that those astronomers who specialize in planetary observations will be hard at work on him.

While all this is going on, Jupiter is in Scorpio past opposition but conspicuous—though very far south; and he remains in sight until about 2 A. M. in the middle of the month. Saturn is in Virgo and comes into quadrature with the sun on the 18th, by which time he may be called an evening star, as he sets before midnight.

Uranus is on the borders of Aquarius and Pisces, and crosses the meridian at 3:54 A. M. on the 15th. Neptune is in Leo but too near the sun to be observed at any time in July.

The moon is new at 1 A. M. on the 2nd, in her first quarter at 5 P. M. on the 9th, full at 7 A. M. on the 16th, in her last quarter at noon on the 23rd, and new again at 3 P. M. on the 31st. She is nearest the earth on the 14th, and farthest away on the 26th. During the month she passes near Mercury and Venus on the 1st, Neptune on the 5th, Saturn on the 10th, Jupiter on the 13th, Mars on the 19th, Uranus on the 20th, and Venus again on the 28th. None of these conjunctions is particularly close.

A partial eclipse of the sun occurs on the 31st, but is of little importance, being observable only in the extreme portion of South Africa (just at sunset), in the southern ocean, and on the Antarctic continent.

Mensurational Characteristics of Photographic Film

PHOTOGRAPHIC film has only comparatively recently come into use in scientific investigation, making it necessary to study the properties of the film as such, to insure that its peculiarities be not projected in the investigator's mind upon the subject matter.

The observation of Cheshire and of Curtis, that photographic film is subject to large and irregular contraction on development, is confirmed only in the case of non-curling film. For motion picture, aerial, portrait, and process film, the contractions and irregularities are found to be considerably less. The changes in length and width are different, the length of a film showing increased effect, due probably to strains in the roll. Films of all kinds are subject to parallel changes in length from day to day and from winter to summer, due to humidity conditions. There is no local distortion in portrait film or in motion picture and aerial. Local distortions of 10 microns sometimes appear in NC film on development, which, however, gradually disappear in a few days. A full discussion is contributed by F. E. Ross to the Astrophysical Journal for April, 1924.

What Happens in the Lime Cycle?

ONE OF the most abundant of all minerals is limestone. It occurs in the earth in various forms and is used for different purposes, according to the properties that it possesses, which are dependent purely on its physical make-up. Chemically, all these forms are fundamentally the same. Thus one variety of limestone is used for building purposes, such as Indiana limestone. Another variety is known as marble and is employed in high-grade constructions. Still another, found only in certain parts of Italy, is known as Carrara marble and is employed in making the finest kind of statuary.

But the most important of all limestones from the commercial standpoint is the common variety which is quarried for the purpose of being converted into lime, then to be used for a great variety of purposes among which one of the most useful and most significant is in making mortar, plaster and the like for building structures of all sorts. Limestone is also ground up and mixed with cement rock and then burnt in the cement kiln to give cement. The purpose of incorporating the limestone with the cement rock is the same that leads the builder to use it in making mortar and plaster.

Limestone is a rather extraordinary substance in that it can be made to give up one of the constituent parts of its molecule with the formation of a powdery substance, quicklime, which can then be mixed with water and sand and made into a plastic mass. This, on exposure to the air, takes up again the constituent that the original limestone lost and is converted into the same hard, durable mass as it was in the first place. This is known as the lime cycle and is the fundamental principle on which building construction depends.

Thus the original limestone is burnt in a lime kiln. Any moisture that it may contain is driven off and eventually it is decomposed into quicklime and carbonic acid gas. Quicklime is a powdery substance which unites with water to give milk of lime, a substance which also has medicinal uses. When the plasterer makes his plaster, a familiar sight in front of a building under course of construction, the steam which is evolved from the milky mixture of quicklime and water is due to the heat generated in the formation of milk of lime. After sand is mixed with the lime, mortar is obtained.

The bricklayer uses the mortar to act as a joint between the bricks that he uses in building up the wall. At first the mortar is soft and plastic so that it can be spread with a trowel. But after a while it commences to harden and eventually becomes even harder than the very bricks that it holds together. The same phenomenon takes place when plaster is used to cover the rough brick or wooden surface of the wall. The action of setting or hardening is caused by the combination of the milk of lime in the mortar and plaster with the carbonic acid gas in the air. The result is limestone, the same substance chemically that was originally used to manufacture quicklime.

Sometimes plasterers are seen to build a fire right in the room they have plastered. The purpose of this is to cause the plaster to set more rapidly, for the heat evaporates the water more quickly and furthermore, the combustion provides a greater supply of carbonic acid gas for combination with the lime.

When cement is poured into molds and allowed to set or harden, the action that takes place is exactly the same. The lime cycle is being completed in this case as well as in the case of ordinary plaster or mortar. Thus, the carbon dioxide which was originally a part of the limestone mined from the earth, and which was liberated and allowed to escape into the air during the process of burning lime, is caused again to combine with lime to give limestone. This is the hard substance that forms when cement or mortar sets. The time of setting is also important and can be controlled by the addition of the various substances to the cement.

What Happens When Leather Is Tanned?

THE SKINS or hides of animals, being organic matter and of similar nature to flesh, will decompose and putrefy when left in the moist state. When the skins are dried, they become very hard and horny, which features are objectionable for many reasons, let alone rendering them unfit for use except for certain unimportant purposes. The main reason for tanning hides and skins and converting them into leather is to prevent them from spoiling and perishing so quickly, but at the same time render them soft and flexible enough to be usable in various ways.

The nature of the tanning process varies greatly and the variation therein allows the manufacture of such diversified leathers as sole leather, light kid, etc. But it must not be thought that the tanning operation is the only factor which controls the properties of the finished product. The finish that is given to the leather also determines the character of the same. Thus patent leather, suede leather, enamel leather, glove leather, etc., depend on the after-treatment as much as on the tanning process.

The skin of hide is composed of two layers. The top layer is known as the epidermis or cuticle, and the bottom layer or derma, also called the true skin. In making leather the epidermis is completely removed before the actual tanning operation is reached. Hence leather is made from the true skin only, which is composed principally of fibrous material.

After the hair has been removed from the hide, as well as any flesh that may adhere to it, and it is properly softened up, the hide is allowed to remain in a vat containing tannin materials. Vegetable tannins are used for this purpose and they comprise such materials as hemlock bark, chestnut extract, quebracho, mangrove bark, and others. All contain tannic acid, and this is the active principle which combines with the organic matter of the hide to convert it into the substance we know as leather. The vegetable tanning process gives sole leathers, leathers for uppers, harness leather and the like. The main disadvantage with the process is the time taken in its completion.

Chrome tanning is a comparatively new process and is chemical in nature. A chemical—a salt of the metal chromium—is employed in the process. It is much more rapid than the vegetable tanning method and it gives a leather which is more resistant to water than the ordinary bark-tanned leather. In this case the chemical combines with the putrescible matter in the hides and converts it into a non-decomposable form.

Leather is also tanned by means of the common substance alum. This method is used for making white glove leather, white kid and the like. Another method of tanning, which, by the way, is the earliest tanning method known, uses the oil, fat and brains of animals. These substances become thoroughly impregnated with the skin and preserve it from decomposing. This process is employed for manufacture of chamois, buff and buck leather.

In connection with the tanning of leather it is interesting to note that there is a common fallacy current that the reason why shoes pinch when first worn is the fact that the leather contains tannin or lime. There is no lime in leather and it is unreasonable to ascribe this action to tannin. It has been assigned to the absorption of moisture from the foot which thickens the leather and shrinks the opening for the foot.

Recently, an interesting development in the tanning process has taken place with respect to the shortening of the time it takes to tan the leather. This has been done by invoking the aid of electricity. The electric current is used to cause the tan liquors better and more rapidly to penetrate into the hide structure. A current is passed through the tan bath while the hide is immersed in it, and the electrolitic action of electricity on the tannin solution permits the latter to work its way into the fine capillary passages of the hide much more quickly and more effectively than when the hides are simply soaked in the tanning bath as heretofore.

What Happens in the Baking of Bread?

BREAD, the staff of life, is baked from a mixture whose main ingredient is flour. Flour is a product obtained from grain or cereal plants, the principal constituent of which is starch. Starch is a white substance of complex chemical make-up, which is absolutely indigestible in the raw state, but which is closely allied to the more digestible substances, dextrin and sugar. The principal food value of bread or cake lies in the starch that it contains, and when this starch is changed by baking into the proper form, it is readily digested by the juices of the stomach which convert it into a primary sugar, dextrose, which is absorbed by the blood current and used as a fuel in the various processes that go on in the human system.

The sole purpose of baking is, therefore to render the starchy constituents—the others are affected as well—of the flour digestible. Everyone knows that there are certain preliminary steps that are taken before the bread is baked. In the first place the dough is made. This process consists of mixing together various ingredients which are commonly employed in making a bread batch. These ingredients are flour, water, yeast, salt, sugar, milk powder, lard or compound fat, malt extract and perhaps different chemicals which give the bread certain specific properties, as, for example, the ability to remain apparently fresh over comparatively long periods of time. In a modern bakery the mixing operation is performed by machinery, after which the dough is put into bread pans and allowed to remain for a specified length of time.

During this time the first chemical change takes place and the dough rises. That this is an important matter will be testified to by everyone who has eaten bread or cake that did not rise properly and was proverbially "heavy as lead." The action of the yeast is to induce the fermentation of the dough. This is accompanied by the generation of gas which puffs up the dough and causes it to "rise," or, in other words, to increase in volume. The gas that is evolved is carbonic acid gas, the same gas that is used in the manufacture of soda water and soft drinks. There are minute living organisms present in the flour which also have some influence on the action of the yeast in causing the bread to rise; and the character of the flour and of the yeast that are mixed together must be taken into consideration if a bread of proper quality is to be obtained.

After the dough has risen, it is ready to be baked. The leavened dough, as it is introduced into the bake oven, contains imprisoned carbonic acid gas. The heat of the oven has for its first effect the expansion of this gas and the further increase in the size of the loaf of bread. When a slice of bread is cut from the loaf, the holes brought to view represent the movement of the carbonic acid gas that was imprisoned in the dough.

The heat of the oven causes the outside of the loaf to form a crust, which is composed of dextrin and a certain amount of caramelized sugar. This hard coating over the loaf of bread prevents the escape of the imprisoned gas within the loaf and makes it possible to obtain a "light," palatable, easily digested bread. The heat has also burst the starch cells and converted them into a digestible form.

It must be mentioned that during the fermentation process certain constituents of the flour, known as enzymes, exert their action to break down the starchy and glutenous constituents of the flour and bring them into the proper digestible form.

In the baking of various kinds of bread, the details are varied to secure different results. Thus to make Vienna bread or rolls, the bread is washed with a solution of starch immediately after baking to give the bread a glossy crust. Rye breads are made from rye flour, white bread from specially prepared wheat flour, whole wheat bread from the entire flour, and so on.

In baking cake and pastry, yeast is not employed, but baking powder is added to the dough mixture. Under the effect of heat, the baking powder is decomposed and generates carbonic acid gas which causes the dough to rise and give a properly baked cake.

Chinese Hair-Net Industry

THE hair-net business in China has had quite a history. It was established originally by Germans, who imported the nets from Chefoo into Germany and then exported them to the United States as European-made hair nets. There is still considerable export of human hair nets from China to European countries. When direct trade in human-hair nets was taken up with China, large quantities of imperfect, undersized and generally poor nets were exported. This finally resulted in the establishment in Chefoo and Tsinan, by the foreign and a few larger Chinese exporters, of hair-net inspection factories, some employing as many as 1000 operatives where hair-net cargoes are inspected and, if necessary, the nets repaired before being shipped. The net-making itself is a home or "cottage" industry; the hair is distributed around in the various villages—in the hinterland of Chefoo and in the region of the Shantung Railway—and the nets usually pass through the hands of several Chinese middlemen before they are offered by the Chinese dealers to exporters.

Physiology of Amoeboid Movement

IN a recent number of the *Journal* of the Marine Biological Association (British) Mr. C. F. A. Pantin discusses the physiology of amoeboid movement as observed in marine amoebae of the limax type. The author finds that this organism can be looked upon as a contracting tube of gelated ectoplasm closed at the posterior end; the anterior end is occupied by the fluid ectoplasm of the advancing pseudopodium. The fluid endoplasm streams forward through this tube from a place of liquefaction within the posterior end of the Amoeba. On reaching the anterior end, the streaming endoplasm apparently forms the fluid ectoplasm of the advancing pseudopodium. This fluid ectoplasm adds continuously to the contracting tube by gelation at the sides of the pseudopodium. Mr. Pantin brings forward evidence in favor of the view that the swelling and liquefaction of the anterior ectoplasm is due to the liberation of an acid, and that on removal of the acid the imbibed water is lost and the ectoplasm contracts. This contraction helps to push the pseudopodium forward. This indicates that amoeboid movement may have a fundamental similarity to muscular contraction and ciliary movement. So far as Mr. Pantin has investigated the relationship of amoeboid movement to the properties of the medium, he has found it to be parallel to that of other forms of contraction. In acid media Amoebae ultimately cease to move, but the loss of movement is entirely removed on raising the alkalinity of the medium. Experiments with water of varying osmotic pressure show that movement is only possible when the water content of the cell lies within certain limits.—*Abstract from Nature* for Feb. 2, 1924.

Self-Igniting Water Lights

"MAN overboard!" A serious situation at any time, but especially so when the accident happens at night. In the first place, a buoy must be thrown to the unfortunate victim so that he can keep afloat until the ship is stopped and brought back to rescue him. In the second place, those on board the ship must be able to find the man when they return. Every ship is equipped with ring buoys which will keep a man afloat in the water. In order that they may not lose their usefulness at night, the Steamboat Inspection Service of the Department of Commerce requires that part, at least, of the buoys be equipped with self-igniting water lights. These lights consist of a copper cylinder containing calcium carbide and calcium phosphide. The cylinder is air and water tight but has a plug which is automatically removed when the buoy is thrown from the ship. When water, flowing in through one of the two holes thus opened, strikes the carbide, acetylene gas is generated which escapes in a stream through the other hole in the top of the cylinder. When the calcium phosphide becomes wet a small flame is produced which ignites the stream of acetylene.

Laboratory test of the new water lights which ignite and cast their powerful rays upon contact with water

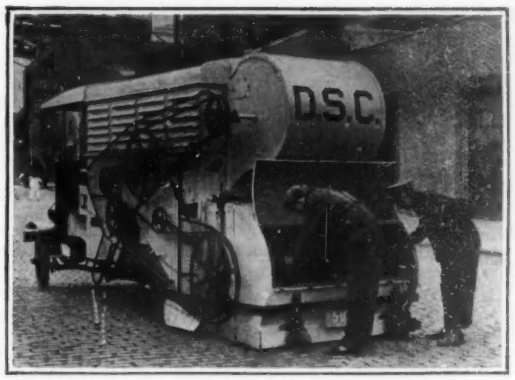
The man who has fallen overboard in the darkness sees the light which has an intensity of 150 candles. He swims toward it, finds the buoy, and is supported until the ship has returned. There is ample time for this since the light continues to burn for a period of 45 minutes. It lights within a minute after it strikes the water and reignites immediately if the flame is put out by being submerged.

Our photograph shows two of these lights in operation in a laboratory test. The instrument in the foreground is a portable photometer by means of which the candlepower is being measured.

A Vacuum Cleaner for the City Streets

AMONG other problems which keep inventive talent ever busy is the mechanical sweeping of city streets. Most large cities have time and again experimented with various types of mechanical sweepers, only to give them up in favor of the good old-fashioned broom and brawn method. Still, a few mechanical sweepers have stood the acid test of practical use and have come through satisfactorily.

The latest thing in mechanical street sweeping is the interesting machine shown in the accompanying view, which is now being used by the Street Cleaning Department of New York City, after completing a series of successful trials. This machine is provided with a power-driven brush at the rear, which sweeps the street pavement and drives the dust into a powerful suction stream which in turn delivers the dust to a number of containers. After the containers are filled, they are removed from the machine and placed on the sidewalk for collection by the usual wagons or motor trucks of the Department.



Very much like Milady's suction sweeper but on a vastly larger scale than its household prototype, is this latest street-cleaning machine

Another recent version of the street-cleaning machine idea, this time an attachment for the gasoline tractor that keeps the rails free of snow

When the Tractor Turns Street Sweeper

DURING the past winter the familiar gasoline tractor, for which so many uses have already been found, was pressed into service as a street, sidewalk, track and snow sweeper, all in one. Small street railways have found the tractor outfit far less expensive to operate than the usual electric snow-plow, and where there are long stretches of little used streets, municipalities have been using the tractor to clear a path through snow. Last winter a Des Moines street railway used this tractor sweeper successfully to keep its tracks clear of snow.

The tractor, which is shown in the accompanying view, is equipped with a snow and street brush. It makes a highly efficient, practical and economical unit for general street-cleaning work. It will handle snow ten to twelve inches deep, making a clean sweep and keeping the path clear for the tractor itself. Being driven direct from the tractor motor and working ahead in plain view of the operator, it can be maneuvered at will.

A Powder House Constructed of Concrete

A POWDER house used by a Utah mining company is unique in design and is constructed in such a manner that should an explosion occur in it the structure would disintegrate instead of sailing through the air to light on some neighbor's barn. No large aggregates were used in the concrete, so that damage in case of an explosion would be reduced to a minimum. The house has the shape of a catenary, which allows for the least possible amount of reinforcement, while the roof is covered with a composition material. The door is made of concrete.

Powder house of concrete which reduces danger in the event of an explosion of the contents

Some Forces in Social Evolution

THE three primary reactions self-preservation, nutrition and reproduction, man possesses in common with all the lower animals. Without these impulses no form of life could perpetuate its kind; they must thus have been present at the appearance of life upon earth. These impulses were present in the protozoon, jelly-fish and worm. When the parental instinct, the next of the prominent social forces to be evolved, first made its appearance, is impossible to say. It was without much doubt present in the higher fish of the middle Mesozoic and also in the reptiles and mammals of the same time, for it is present in those forms of these types which have survived to the present. For example, many fish, such as the sunfish, are vigilant in the protection of their nests.

Later in time there developed among some mammals an association of individuals for the betterment of their protection, food-supply and care of young. Through this association into herds and packs certain modifications in the behavior of the individuals must naturally take place. There would develop, for example, a susceptibility to leadership, since those individuals that failed to respond quickly would be killed off by the carnivores and thus leave no offspring. Similarly, any decided originality in conduct would be obliterated, since it would tend to expose not only the individual but the entire herd to danger. All members of the herd would thus develop the same fixed mental reactions to all ordinary happenings.

These mental reactions would be impressed upon succeeding generations of primates and earlier social mammals through the successful survival of the individuals exhibiting them. Today, through natural inheritance, we find them impressed upon man's body. In man we recognize the herd instinct in many characteristic reactions. Thus decided originality in conduct is looked upon with suspicion. What the majority say or do is right. Each individual has fixed ideas; that is, his mental reactions are governed by what those individuals with whom he most associates say is proper. The herd is the individual's normal environment, so that he is fearful of solitude, physical or mental. Accordingly, he is remarkably susceptible to leadership. He is subject to the passions of the pack. Indeed, he is more sensitive to the voice of the herd than to any other influence; it can inhibit or stimulate conduct, courage, energy, endurance.

In addition to the gradual expansion of consciousness through the avenues of instinct, man's prehuman forebears constantly gained a larger control over their surroundings through the increasing mass of knowledge possessed by the herd as an inheritance from the past. The lowest animals have only the knowledge with which they are born. Each may add a very slight amount to his own inheritance during his life, but can teach none of what he learns to his offspring. With the appearance of the parental instinct, however, and the consequent increasing care of the young, there enters the imitation of parent by offspring, whereby some knowledge is continued as a sort of tradition in addition to that handed down through the generations by birth inheritance. And with the coming of the herd the young, associating intimately and long with many individuals, find their imitative faculty expanded and the knowledge of their environment greatly broadened. Finally, in man this knowledge is tremendously enlarged through the development of the more precise communication between individuals that follows from articulate speech.—*Abstract from article by Prof. H. W. Shinev, Science, February 29, 1924.*

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Aeronautics

METAL CONSTRUCTION FOR AIRCRAFT—Particularly relating to the construction of spars, comprising a vertical web formed of separate plates presenting a tubular formation. Patent 1485246. E. E. Brown and D. J. Mooney, c/o D. J. Mooney, 480 Gillingham St., Victoria S. W., London, England.

Pertaining to Apparel

CAP—In which ventilation or non-ventilation is provided through the visor, as desired. Patent 1486102. P. Merton, c/o C. S. Merton Co., 201 5th Ave., New York, N. Y.

NECKTIE—Of such construction that it is especially adapted to be used as a bow or bat tie. Patent 1486822. I. D. and F. E. Wolfson, c/o I. D. Wolfson Co., 10 E. 39th St., New York, N. Y.

Chemical Processes

METHOD OF RECOVERING GASOLINE—From natural gas, crude oil and the like, wherein the gas and oil are combined to increase the amount of hydrocarbon. Patent 1484922. La Van Warren, c/o William Brink, Henryetta, Okla.

PROCESS FOR DEFECATING SUGAR JUICE—In which the juice is first treated with lime to strong alkalinity, and after the removal of the precipitate formed, sodium phosphate is added to precipitate the excess of lime. Patent 1486091. W. D. Horne, 175 Park Ave., Yonkers, N. Y.

Electrical Devices

ELECTRIC FLATIRON—In which the body member is of a molded non-metallic material and the heating element disposed therein. Patent 1484773. A. Grouleff and H. A. Holmes, 223 E. Delaware Place, Chicago, Ill.

RADIO BATTERY CONSTRUCTION—Whereby leakage or creepage on the cover will be so minimized as not to cause short circuit. Patent 1485282. P. M. Marko, 1402 Atlantic Ave., Brooklyn, N. Y.

GAS PRODUCER—With means for electrically and automatically controlling the output in accordance with the temperature. Patent 1486047. D. J. Smith, 40 Woodberry Grove, Finsbury Park, London, N. 4, England.

ELECTRIC CONNECTION — Whereby two threaded members of soft material, such as lead, can be connected together, as in battery cell covers. Patent 1486250. M. C. King, Universal Battery Co., 3410 S. La Salle St., Chicago, Ill.

ELECTRIC FITTING—Adapted for use in connection with electric lamps made to imitate candles. Patent 1486815. J. T. Trotter, 368 Gates Ave., Brooklyn, N. Y.

FLY TRAP—Which is electrically energized and provided with means for attracting the flies to their electrocution. Patent 1486307. C. G. Seefluth and J. Bebiolka, 519 So. Saginaw St., Pontiac, Mich.

ELECTRIC CLOCK—Which is self-winding, and will close an electric actuating circuit when the clock becomes inactive. Patent 1483783. U. L. Collins, 120 22d St., San Diego, Cal.

Of Interest to Farmers

SOIL PULVERIZER—Of rotary shovel assemblage, and adapted to be drawn over a field by draft animals. Patent 1483743. F. H. Page, Waverly, Iowa.

PLANTING AND MARKING MACHINE—Of such construction that the marker will appear in the exact line with the planted seed. Patent 1483815. O. H. Kohlhaas, Calumet, Mich.

SILO—So constructed that the door and its fastening means constitute the ladder of the silo. Patent 1485679. L. D. Houghtaling, Box 91, Reading, Pa.

FRAME WIRING DEVICE—For wiring honey frames such as are used in the bee industry. Patent 1486809. L. E. Starr, 112 Marion Ave., Pasadena, Cal.

WHAT IS A TRADEMARK?

A TRADEMARK as distinguished from such statutory creations as patent rights, is a common law right. Its origin is not modern, for proof of trademark usage is found in remote antiquity. A trademark is a name, word, symbol or the like by means of which its owner indicates to the consumer the origin of the merchandise to which it is applied. While a trademark is an intangible property, it cannot be dissociated from physical application in some manner, to merchandise, nor can a trademark right be dissociated from use thereof. There is no right of invention in a trademark—the one who first uses it owns it, even if he did not create it. Under our law at least, trademark registration confers no ownership therein, and a prior user of an unregistered mark can defeat the right of a later registrant of the same trademark applied to the same merchandise. The registration of a trademark in the United States may be compared to the recording of a deed of ownership, though the statutes covering registration confer additional benefits not incidental to the pure common law trademark. Strangely enough, even a registered trademark has no element of monopoly therein, for the very fact that a trademark indicates the merchandise of one purveyor from those of another.

Of General Interest

COMBINED THIMBLE AND THREAD CUTTER. In which the thimble end is formed with a narrow slot containing a cutter. Patent 1483823. Queene E. Marrs, c/o Roy Bates, Box 117, Navada, Mo.

FILE—Comprising a letter file which may be collapsed or distended, and readily secured to the side of a desk. Patent 1483799. W. Hall, 270 E. 176th St., Bronx, N. Y.

MOVABLE CAP FOR SMOKESTACKS—With valve means for controlling the draft pressure. Patent 1483784. W. A. Collver, 240 Hall Ave., Marshfield, Ore.

FOLDING MATCH SAFE—For new and burnt matches, made from a single blank folded to form upper and lower compartments. Patent 1483747. W. Sammis, 617 St. Johns Place, Brooklyn, N. Y.

PHONOGRAPH RECORD—With means for facilitating the proper placement of the needle to prevent scratching the record. Patent 1483751. L. Slingland, 137 Ellisen St., Paterson, N. J.

LOOSE-LEAF BINDER—Adapted to frictionally hold sheets even though the openings of the sheets are larger than the sectional posts. Patent 1483123. A. G. Siegert, 1250 W. 97th Place, Chicago, Ill.

BRACELET—Comprising a plurality of flexible links each constructed to support a jewel. Patent 1483132. K. L. Toelcke, A. Mikko'a and L. Shapiro, c/o Master Jewelry Co., 1204 Heyworth Bldg., Chicago, Ill.

COAL SAVER—In the form of a liquid composition to be sprayed on the coal, producing a hotter fire and eliminating clinkers. Patent 1483528. W. H. Stiefel, Angola, Ind.

LOOSE-LEAF BINDER—Which may be adjusted to hold various quantities of leaves, and firmly secured against accidental opening. Patent 1483388. B. P. Shepherd and M. Hotchkiss, c/o Marshall & Bruce, 162 4th Ave. No., Nashville, Tenn.

COMBINED BRUSH AND SCRAPER — For household use constructed to reach the corners or edges of kitchen cabinets, stoves, refrigerators, etc. Patent 1483760. G. Yoshizawa, 3127 Buchanan St., San Francisco, Cal.

FLOOR POLISHER—Whereby a plurality of elements such as brushes are pressed into contact and rotated against the floor. Patent 1485080. W. H. Hughes, 1422 Chase St., Falls City, Neb.

TAG HOLDER AND BOX PULL—Particularly adapted for use in connection with stock boxes containing shoe. Patent 1486004. G. C. Backus, 1407 E. 82d St., Suite 5, Cleveland, Ohio.

VENTILATOR—For show windows, or similar enclosures, to prevent the collection of steam or frost thereon. Patent 1486084. G. W. Gearhart, 1004 Center St., Ashland, Pa.

HOLDER FOR PAPER NAPKINS—That will permit of the delivery of the napkins in single succession. Patent 1486079. J. M. Fernandez, 229 E. 95th St., New York, N. Y.

CHICKEN FEEDER—That will prevent the chickens from scratching the feed out of the container. Patent 1485672. Mary E. Fielden, 152 Sherman St., Ashland, Oregon.

COMPUTING DEVICE—For facilitating the location of house numbers relative to streets intersecting the streets on which said numbers appear. Patent 1486082. C. B. Fowler, 9422 215th St., Queens, Long Island, N. Y.

DOOR GRILL—Which is simple and readily adjustable for the apertures of doors or windows. Patent 1486038. T. C. Rush, c/o Hay Hardware Co., Lexington, Ky.

DEVICE FOR DRIVING FISH—The device is adapted to be submerged to drive the fishes in a predetermined direction. Patent 1486,083. C. K. Freer, 129 E. 3d St., Port Clinton, Ohio.

KEY CHAIN REEL—In which the key may be drawn from a housing and will return thereto by spring pressure. Patent 1485663. W. Best, 2139 West North Ave., Chicago, Ill.

TEMPLATE—By means of which a monetary document may be torn to indicate the amount to be paid. Patent 1485708. G. E. and E. L. Potter, 190 N. State St., Chicago, Ill.

CLASP—For arm bands and the like, which is convenient to handle and will not injure the material. Patent 1485694. H. J. Nordseth, 1241 Naples St., San Francisco, Cal.

KEY RING—Which is exceedingly easy to manipulate for locking a key thereon or releasing the same. Patent 1484532. J. B. Quigley, Box 82, Independence, Missouri.

TRAP—Of the type known as steel traps with trigger construction, for catching rats, and various animals. Patent 1484363. J. A. Tubbs, Box 423, El Paso, Texas.

SIGN SUPPORTING AND SUSPENDING MEANS—Whereby signs of any dimension may be suspended in a neat and artistic manner. Patent 1484231. V. L. Pistocco, 722 Wall St., Wichita Falls, Texas.

DISCHARGE MEMBER FOR USE IN IRRIGATING SYSTEMS—Of simplified construction for use in connection with lawns and flower beds of the home garden. Patent 1484575. N. P. Shulin, 1040 W. Porphyry St., Butte, Montana.

ACCELERATOR—For use in connection with automatic fire extinguishers of the sprinkler type. Patent 1483952. F. B. Quackenboss and J. A. Neale, Stahlman Bldg., Nashville, Tenn.

AUTOMATIC REPOURING COFFEE URN—Wherein water, or the percolated coffee, may be passed through the ground coffee any desired number of times. Patent 1484537. J. V. Wells, 161 W. 36th St., New York, N. Y.

METHOD OF CONSTRUCTING CONCRETE WALLS—Whereby in forming walls, columns, etc., the surface may be made to present an ornamental appearance. Patent 1484484. E. Flagg, 111 E. 40th St., New York, N. Y.

BOTTLE—For perfume, the perfume being discharged under pressure through a capillary passage in the stopper of the bottle. Patent 1484589. L. Trubek, 138 Central Ave., Hasbrouck Heights, N. J.

MOTH BALL HOLDER—Whereby the insect repellents may be held in proper position and periodically replenished as they evaporate. Patent 1484510. R. J. Lewers, 1888 Cedar Ave., New York, N. Y.

SIGHT BASE FOR FIREARMS—Designed for mounting a peep-sight on a rifle having a sliding bolt breach mechanism. Patent 1483,925. L. C. Booth, 524 Summer St., Sheridan, Wyoming.

CUFF LINK—Having mechanism encased within the tubular portion of the link, for locking the separable members. Patent 1484788. F. Keller, 1942 Fletcher St., Chicago, Ill.

CLEAN-OUT DEVICE FOR PIPES—In the form of a clean-out plug which can be readily opened for cleaning the pipe. Patent 1484,469. S. Brucelarie, 721 Shippen St., West Hoboken, N. J.

SELF-FILLING FOUNTAIN PEN—With simplified device for effecting movement of the pressure bar to collapse the ink sack. Patent 1484683. L. M. Tebbel, c/o Munn, Anderson & Munn, Woolworth Bldg., New York, N. Y.

ARTIFICIAL BODY MEMBER—Capable of performing all of the important functions of the human arm and hand. Patent 1484913. C. M. Surry, 216 E. Choctaw Ave., McAlester, Okla.

SIGNPOST—In the nature of a combined advertising sign and direction guide post for use on highways. Patent 1484804. C. L. Terry, c/o Wallace & Cameron, 415 Caples Bldg., El Paso, Texas.

BACKBAND HOOK—Providing for ready connection with a brace chain, and the prevention of accidental displacement of the same. Patent 1484986. J. W. Crim, 1614 Hampton Ave., Columbia, S. C.

HAIRCLOTH FABRIC—For stiffening garments, whereby the filling hairs cannot become disarranged or escape. Patent 1484,669. V. Pastore, 41 Green St., New London, Conn.

UTENSIL FOR THE TREATMENT OF FOODSTUFFS—By means of which the interior of a ham, or other large articles of food may be thoroughly cooked. Patent 1485253. E. S. Devlin, 1445 University Ave., New York, N. Y.

FLUID-TIGHT JOINT FOR PIPES FOR FLUIDS UNDER PRESSURE—Comprising a joint ring and a ball-bearing connection for the pipes, and a flexible metal tightening ring. Patent 1485252. L. L. B. Denis, 116 Boulevard de Menilmontant, Paris, France.

SILL CONSTRUCTION—Whereby the sash members form a very tight construction against air and the elements. Patent 1485,307. J. F. Steckenreiter, 426 Prince St., San Francisco, Cal.

INKSTAND—In which the opening for the pen is normally closed against dust by a floating bale valve. Patent 1485255. H. M. Dungan, Oregon, Missouri.

TELLURIAN—For showing the operation of the causes which produce day and night in succession, and the changes of the season. Patent 1485322. S. A. Winetzky, 1772 Weeks Ave., New York, N. Y.

RAZOR STROP—Which may be held in operative position on one hand while the other hand manipulates a safety razor. Patent 1485350. J. W. Shepard, Tucson, Arizona.

ASH-TRAY MOUNTING—For associating an ash receptacle with a chair, table, piano or other article of furniture. Patent 1485223. C. A. Greene, 152 W. 45th St., New York, N. Y.

EGG POACHER — Which facilitates the handling of the eggs and prevents breaking of the yolks. Patent 1485237. H. Parodi, 179 E. 109th St., New York, N. Y.

WOOD SUBSTITUTE—Comprising sawdust, talc, cork, and shellac as a binder which when molded to form, is non-inflammable. Patent 1485303. J. W. Sheridan, 41 Halsey St., Astoria, N. Y.

SOUND CLARIFIER—Particularly intended for use in connection with talking machine, although not limited in this respect. Patent 1485348. C. W. Johnson, Box 59, General P. O., New York, N. Y.

PARTITION CONSTRUCTION—The object being to provide a substitute for mold boards, and surbases, as commonly made. Patent 1485262. E. Flagg, 111 East 40th St., New York, N. Y.

INK BOTTLE AND INK POT—With means for supplying the correct depth of ink in the ink-well. Patent 1486812. G. Sweetser, 73 Gipsey Hill, London, S. E., England.

VENTILATING SYSTEM — By means of which an entire floor or a number of floors may be ventilated, in large buildings. Patent 1486739. E. Glantzberg, c/o Typhona Fan Co., 345 W. 39th St., New York, N. Y.

AIR GUN—With means for controlling the pressure fluid to the bore of the barrel. Patent 1486215. L. F. J. Zerbee, Fort Leavenworth, Kans.

LABIATE DOOR FOR PHONOGRAPH CABINETS—Which is adjustable at the mouth of the amplifying horn to regulate the volume of sound. Patent 1486254. W. T. Lakin, Long, Md.

FISHERMAN'S BELT—For carrying bait, a knife, leaders and other necessary articles for use on a fishing trip. Patent 1486470. R. W. Welch, Kelso, Wash.

GLASS MOSAIC—With a back facing which will enable it to be seated on a cementitious base. Patent 1485753. E. Zundel, Hollis, Long Island, N. Y.

Hardware and Tools

NUT LOCK—For holding a nut releasably locked to a bolt, and against accidental displacement. Patent 1483924. F. L. Bixby, T. R. Gibson and E. W. Cheney, c/o Cheney & Lunsford, Attys., Reno, Nev.

UNDERREAMER—For use in connection with rotary drilling rigs, and having means whereby the bits are automatically expanded. Patent 1485249. G. H. Craig, Box 1199, Monroe, La.

NUT LOCK—With an inner split nut and an outer nut screwed onto the split nut with split keys engaging grooves. Patent 1485090. T. A. Passic, 418 Suffolk St., Ironwood, Mich.

EXTENSIBLE CLAMP—By means of which one screw head is usable with a series of different length bars. Patent 1484794. M. H. Moses, 1440A Pacific St., San Francisco, Cal.

SASH GRIP—So arranged that they may be secured to either upper or lower sash for raising or lowering the window. Patent 1485285. J. T. O'Gorman, 1968 Morris Ave., Bronx, N. Y.

ADJUSTABLE VISE-LOCKING SCREW—Such as are used for typesetting machines. Patent 1485670. H. L. Eigenbrot, 25 Curtis St., San Francisco, Cal.

ELEVATOR DOORLOCK—Which automatically locks the door when closed, and which has no unsightly protruding parts. Patent 1486093. J. B. Kaiser, Hotel Placer, Helena, Mont.

JACK—Constructed with a snugly fitting tubular body, with rack bars at opposite sides. Patent 1486797. G. A. Piper, c/o George W. Lang, Bridgewater, So. Dak.

KNIFE—In which the blade is firmly held when in open position, for use by hunters, fishermen, gardeners, and the like. Patent 1486725. V. R. Brown, c/o Union Cutlery Co., Olean, N. Y.

PRUNING IMPLEMENT—For severing the limbs of trees or shrubbery by a pulling or pushing action upon the handle. Patent 1486538. B. F. Nightlinger, Duluth, Minn.

Heating and Lighting

FIREPLACE LINING—Composed of four sections which may be easily assembled and adjusted to the size desired. Patent 1483384. A. H. Sandstrom, 319 Henry Bldg., Portland, Ore.

SELF-CONTROLLING HEATER — Comprising two conductors and an electric current passed from one to the other, for heating water or other liquid. Patent 1483280. F. H. Cherry, University of California, Berkeley, Cal.

SECTIONAL BOILER—Constructed of cast iron sections and adapted to efficiently utilize and completely consume various grades of fuel. Patent 1486089. M. E. Herbert, Root and La Salle Sts., Chicago, Ill.

RADIANT—For use in gas stoves, giving a greater volume of radiating surface, from a minimum to fuel. Patent 1486036. F. V. Risinger, 1590 Wagar Ave., Lakewood, Ohio.

OIL BURNER—Which functions without forming much carbon, and automatically shuts off fuel when burner ceases to operate. Patent 1486103. J. J. Milnes, 55 Clinton Ave., Port Richmond, S. I., N. Y.

Machines and Mechanical Devices

VENDING MACHINE—Particularly intended for vending cigarettes or similar small packages. Patent 1483309. J. W. McCommins, 845 5th St., San Diego, Cal.

UNLOADING APPARATUS—Of the conveyer type for transferring the contents of a car to a point for further handling. Patent 1483254. D. Terry, 924 8th St., Sacramento, Cal.

STERILIZING APPARATUS — Especially adapted for use in sterilizing milk contained in cans, and controlled by a single operator. Patent 1483325. G. T. Bishop and W. R. Hagerman, 490 Penn Ave., Chehalis, Wash.

MEAT CUTTER—With rotary knife and saw mounted on an overhead support and arranged to be pulled down into cutting position. Patent 1483617. G. B. Runyan, Kusa, Okla.

SLASHER CYLINDER—Such as are used in textile mills for drying yarn to which a finish has been applied. Patent 1483343. E. L. Gladin, 8 Calaway St., Manchester, Ga.

HYDRAULIC EXPANDER FOR WELL DRILLS AND THE LIKE—Which is actuated and held in operative position by the pump at the top of the well. Patent 1483611. J. P. Miller, c/o Terrebonne Gas Co., Houma, La.

PACKING—Which will reduce the wear on a piston, valve, or other devices which move back and forth. Patent 1483750. J. W. Shepard, 227 Bean Ave., Tucson, Ariz.

HAND MACHINE FOR CUTTING OUT SEVERAL THICKNESSES OF FABRIC—Adjustable according to the thickness of the fabric to be cut and the cutting manipulated by one hand. Patent 1483788. E. Duplissis, 63 Rue Pigalle, Paris, France.

GEAR WHEEL—Having a separable hub, and being capable of repair and adjustment for maximum wear. Patent 1483817. A. H. Landry, 8 Western Ave., Howell, Mass.

GILDING APPARATUS—Whereby embossing on surfaces such as leather or similar surfaces can be easily accomplished. Patent 1483780. T. Catala, Hudson Terrace, Englewood, N. J.

AUTOMATIC TIME CLOCK—For the purpose of indicating on a time card the exact time when the card was inserted. Patent 1483820. H. G. Lundgren, c/o Automatic Electrical Machine Co., 1241 High St., Oakland, Cal.

METHOD AND MEANS FOR THE TREATMENT OF FATS AND OILS—As in emulsifying oils or edible fats, in the manufacture of margarin. Patent 1483742. J. S. Nicol, c/o Wm. Douglas & Sons, Douglas Wharf, Putney, London, S. W. 15, England.

DRILLING MACHINE—Of the power track-bonding type, of such weight that it can be lifted and manipulated by one man. Patent 1484809. C. B. Cargile, 1113 Raymond Ave., St. Paul, Minn.

SNOW REMOVAL DEVICE—With means for gathering, elevating, and discharging the snow into a suitable vehicle. Patent 1484,555. J. B. Ghione, 21 Hancock St., New York, N. Y.

FABRIC CUTTER—For cutting fabrics having adhesive coatings superimposed thereon, with means for preventing the adhesive from adhering to the blade. Patent 1484598. F. S. Weniger, c/o Peters Bros. Rubber Co., 160 John St., New York, N. Y.

WELL MEASURING APPARATUS—In which tension rollers are engaged with the cable, and a disk registers the depth of the well. Patent 1484036. R. C. Mason, c/o Mason Mfg. Co., Tulsa, Okla.

FILM AND FILM SUPPORT FOR MOTION-PICTURE MACHINES—Controlled by a coin wherein the film will come to rest when completely exhibited, until another coin is inserted. Patent 1483942. M. Keil, 307 Royal St., New Orleans, La.

MANDREL FOR PAPER-MAKING MACHINES—For winding rolls of paper as the same is delivered, and facilitating the removal of the roll. Patent 1485290. A. Philhower, Morris Plains, N. J.

PROCESS AND APPARATUS FOR MANUFACTURING PAPER—By means of which the width of a sheet of paper may be gaged in the forming thereof, without stopping the machinery. Patent 1485256. J. H. Durkin and D. Wilkie, c/o D. Wilkie, 1900 McCallie Ave., Chattanooga, Tenn.

SHUTTLE THROWING MECHANISM — Constructed to automatically operate the pickers in time with the movement of the lay. Patent 1485310. C. H. Stralucke, 333 Atlantic Ave., Lynbrook, N. Y.

CHOKE NIPPLE FOR OIL LINES—By means of which various sizes of openings may be employed without removing the device from the pipe line. Patent 1485264. M. J. Heald, P. O. Box 32, Tulsa, Okla.

MIDDLINGS MILL—Having mechanism for extracting all the available flour contained in the middlings. Patent 1484715. G. M. Kemp, R. No. 2, c/o Kemp Mfg. Co., Williamsport, Md.

Medical Devices

DENTAL APPLIANCE—For quickly preparing dental molds for use in casting metal fillings. Patent 1484800. J. J. Stark, 564 Senator St., Brooklyn, N. Y.

DENTAL BRIDGEWORK—Which aims to provide means for removably mounting artificial teeth between natural teeth in the mouth. Patent 1485306. J. J. Stark, 564 Senator St., Brooklyn, N. Y.

DENTAL IMPRESSION TRAY—Which may be quickly adjusted to conform to the contour of different sized mouths. Patent 1486,039. J. de J. Santos, 226 W. 17th St., New York, N. Y.

Prime Movers and Their Accessories

PRESSURE GENERATOR—For developing a continuous pressure of combined gas and steam for operating an engine. Patent 1483409. A. N. Blazer, State College, Mescalero, N. M.

CALCULATING SYSTEM FOR INTERNAL-COMBUSTION ENGINES—Adapted to permit the liquid employed as a cooling medium to be used when heated with certain advantages. Patent 1484488. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

CRANK CASE FOR INTERNAL-COMBUSTION ENGINES—Whereby the sediment collected in crank case may be removed without removing the case. Patent 1484043. J. M. Tapley, c/o W. J. Christie & Co., 300 Paris Bldg., Winnipeg, Canada.

SPARK-PLUG CLEANER—Having a blade so shaped that it serves for scraping the various grooves in a plug. Patent 1485347. C. Jacobs, 1768 Weeks Ave., New York, N. Y.

APPARATUS FOR CRACKING HYDROCARBONS AND RECOVERING GASOLINE—Which permits of the blending and cooling of the vapors in such way that a light gasoline substitute is produced. Patent 1485083. M. H. Kotzebue and L. M. Bowman, Box 1963, Tulsa, Okla.

OIL BURNER—By means of which effective atomization of heavy oil and steam may be obtained. Patent 1484993. G. B. Lear, 1606 Fair Place, Shreveport, La.

APPARATUS FOR SUPPLYING VAPORIZED LIQUID FUEL TO INTERNAL-COMBUSTION ENGINES—For the use of the more heavy and less volatile oils, vaporization being effected by rarefaction of the air above the oil. Patent 1486058. P. L. Ta'Bois, 41 Brannerton St., Chelsea S. W., London, England.

ROTARY MOTOR — Adapted to use either gaseous or liquid impelling mediums, and to rotate in either direction. Patent 1486796. R. E. Peniston, Box 13, Lake City, Colo.

COMBUSTION PROMOTER—Adapted to introduce air into the cylinders of motor cylinders with the introduction of the charge of fuel. Patent 1485497. E. I. Emerson, 13 East Ave., Middletown, N. Y.

Pertaining to Vehicles

SPRING DEVICE—In the form of a leaf spring completely housed from deteriorating action of weather or dirt. Patent 1480694. A. R. Roche, 1633 13th Ave., Seattle, Wash.

VEHICLE WHEEL—That may be easily repaired if damaged and that provides resiliency. Patent 1481200. K. P. Hangel, 1133 Tinton Ave., New York, N. Y.

AUTOMOBILE SIGNAL—Particularly adapted to the rear end of a car, visible either by day or night. Patent 1481162. E. Themak, and J. Vitaglione, c/o H. Dahmer, Poole & Park Ave., Union Beach, N. J.

TRUCK SNOW-LOADING DEVICE—Consisting of an inclined bottom with sides which may be adjusted to required angle for filling a truck. Patent 1481438. A. F. A. Schmitt, 281 E. 101st St., New York, N. Y.

SIGN—Which may be used on automobiles, presenting an attractive display for advertising. Patent 1481703. H. C. Forbes and P. E. Sherrill, 5859 Normal Blvd., Chicago, Ill.

SWITCH FOR AUTO TURNING SIGNALS—Arranged for signaling an intended turn or other signal, an appreciable time before the turn is made. Patent 1482248. A. F. Ochtman, Coscob, Conn.

PUMP—For inflating pneumatic tires, with means for actuating the pump by the motive power of the rear driving wheels. Patent 1481820. F. Z. Barrundia, c/o H. Friest Co., 35 So. William St., New York, N. Y.

SIGNALING DEVICE FOR VEHICLES—Adapted to indicate to approaching and following motorists the intended movements of the vehicle signaling. Patent 1483615. D. A. RITCHIE, 127 So. Locust St., Centralia, Ill.

GLARE ELIMINATOR — For use upon the wind shield of a motor vehicle. Patent 1483763. C. H. Anderson, c/o N. W. Military Academy, Walworth, Wis.

VEHICLE WHEEL—Of the disk type in which the disk which supports the tire rim from the hub is detachably associated. Patent 1484535. J. W. Shepard, P. O. Box 344, Tucson, Arizona.

HEADLIGHT—Which prevents glare, but directs a bolt of light for illuminating the road ahead. Patent 1484571. E. C. Searle, c/o J. C. Searle, 1534 D. Magazine St., Honolulu, Hawaii.

AUTOMATIC STARTING DEVICE FOR MOTORS—Whereby an automobile engine may be started by merely pressing a button, and the starter automatically disconnected. Patent 1484539. L. M. Williams and C. J. Jewett, c/o C. J. Jewett, 710-12th St., Fort Smith, Ark.

WHEEL—Which may be constructed of wood or metal, and whereon a demountable rim may be readily arranged. Patent 1484,106. J. R. Young, 1086 Laurel Ave., Akron, Ohio.

HYDRAULIC BRAKE—Which will not burn out in descending steep declivities, nor swell when highly heated. Patent 1485304. S. B. Shoemaker, South Strafford, Vt.

TIRE-RETREADING CORE AND METHOD OF FORMING THE SAME—Which consists in forming a solid body of annular form, cutting it into segmental sections and attaching handle means. Patent 1484994. J. L. Maguire and L. C. Weese, 316 Davis St., Elkins, W. Va.

BRAKE—Adapted to more readily grip the annular brake flange connected with a Ford car. Patent 1484989. H. Hawk, Grampian, Pa.

FOOT CONTROL FOR AUTOMOBILES—Whereby the foot may be carried ready for instant engagement with either of the controls without danger of misplacement. Patent 1485612. H. E. Hull, House Office Bldg., Washington, D. C.

ROAD LIGHT FOR AUTOMOBILES—Mounted to flood the road surface forward of the right front wheel, and without endangering glare. Patent 1485503. T. A. Hendricks, 442 E. Main St., Lexington, Ky.

Designs

DESIGN FOR A LAMP—Patent 63702. C. W. Sinkins, c/o Dean House, Lake Mahopac, N. Y.

DESIGN FOR A DRESS—Patent 63705. E. E. Wolf, address Colony Club Frocks, 148 Madison Ave., New York, N. Y.

DESIGN FOR A PRINTED FABRIC—Patent 63706. L. Bluhm, c/o Phoenix Mfg. Co., 877 Broadway, New York, N. Y.

DESIGN FOR A DECANTER—Patent 63769. P. Bianco, 659 Crescent Ave., Bronx, New York, N. Y.

DESIGN FOR A FLOWERPOT—Patent 63803. G. Reasner, 2343 Grove St., Brooklyn, N. Y.

DESIGN FOR A HAND BAG—Patent 63809—M. Scheuer, c/o R. I. Shank Co., 22 W. 21st St., New York, N. Y.

DESIGN FOR A FLOWERPOT—Patent 63777. P. E. DeYoung Cook, 737 Warburton Ave., Yonkers, N. Y.

DESIGN FOR A PLAQUE—Patent 63795. W. P. Moran, c/o T. B. Clark & Co., Honesdale, Pa.

DESIGN FOR A DOLL—Patent 63846. J. J. Gillooly, Hotel Breslin, 29th St. and Broadway, New York, N. Y.

DESIGN FOR A RADIATOR-CAP ORNAMENT—Patent 64018. C. G. Koch, 633 Hunterdon St., Newark, N. J.

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Of General Interest

EXERCISING APPARATUS — Designed for the reduction of superfluous flesh particularly at the abdomen, hips and legs. Patent 1486732. J. J. Cooper, 56 W. 47th St., New York, N. Y.

METHOD OF CASTING—In permanent molds, and provision for the automatic ejection of the casting at the proper time. Patent 1485,628. H. A. Schwartz, 10221 Pierpont Ave., Cleveland, Ohio.

FOUNTAIN PEN—So constructed that the operating button of the self-filling mechanism is free to turn without injury to the container. Patent 1486246. O. B. Hjorth, c/o Parker Pen Co., Janesville, Wis.

CHAIR—In which a child may be comfortable for a comparatively long period. Patent 1486813. J. A. Tallman, 49 Brickhead Place, Toledo, Ohio.

HAIR WAVING DEVICE—Of the Marcel type, for waving a strand of hair in two directions. Patent 1486786. J. Morenilla, 2417 W. Roosevelt Road, Chicago, Ill.

WATER-RESISTANT ROPE—Made by combining "kapok" (the down of the *Ceiba pentandra*) with the fiber when the rope is formed. Patent 1486800. F. Riesenberg, 10 Henry St., Tuckahoe, N. Y.

FOLDING UMBRELLA—In which the stick ribs and braces may be folded to take comparatively little room. Patent 1486772. A Lopez, 320 57th St., Brooklyn, N. Y.

VANITY CASE—So constructed that a rouge compact and a face powder compact may be readily accessible. Patent 1486764. W. G. Kendall, 118 Market St., Newark, N. J.

ORNAMENTING DEVICE — By means of which a plurality of arms will support ornaments to form clusters simulating natural objects. Patent 1486753. R. C. Hynds, c/o G. Burchard Smith, 165 Broadway, New York.

PENCIL HOLDER—Adapted to safely lock an ordinary pencil in the pocket of the wearer. Patent 1486244. E. O. Hammerberg, 3519 N. Seeley St., Chicago, Ill.

SALT AND PEPPER SHAKER—Consisting of two compartments with means for controlling the passage of the contents from either. Patent 1486262. L. M. Ortiz and S. E. Gilmore, c/o The Orremore Co., 222 So. Clinton St., Chicago, Ill.

REFILL FOR VANITY CASES—Whereby the compact carrier may be readily removed, yet normally retained within the case. Patent 1486765. W. G. Kendall, 118 Market St., Newark, N. J.

Machines and Mechanical Devices

ROLLER CORE DRILL—Having rotary cutters, with recessed bearing means lubricated with heavy grease kept mobile by a mixture of shot. Patent 1484995. J. D. Pace, 214 Commercial Bank Bldg., Box 333, Alexandria, La.

LAWN MOWER SHARPENER—Which effects a proper grinding of the cutters, and ledger plates, without disassembling these elements. Patent 1484708. J. A. Grassman, c/o G. D. Grassman, 19 W. Main St., Palmyra, Pa.

FAN—With mechanism permitting of its movement to direct a blast of air in various directions. Patent 1485241. J. Aronoff, 244 Clinton St., New York, N. Y.

PROPELLER BLADE—So formed that it may be used on flying machines, motor boats, or in small sizes for fans. Patent 1485079. C. F. Hoffmann, 2332 Kenilworth Ave., South Norwood, Ohio.

STIFFENER FOR DIPPER STICKS—Such as are commonly used in connection with steam shovels. Patent 1485633. W. C. Shea, 6200 Bertha St., Los Angeles, Cal.

COTTON GIN—Which is especially adapted for use in "reginning" cotton seed, but will also "gin" cotton. Patent 1485833. F. B. Cumpston, Blooming Grove, Texas.

COMPRESSION PUMP—By means of which a very high degree of compression or vacuum may be obtained. Patent 1485695. E. P. Norman, Box 93, Los Angeles, Cal.

MACHINE FOR CUTTING STUMPS—At a point beneath the soil or earth surrounding the stump, and for removing the severed stump. Patent 1485527. C. Raeber, City Hall, San Antonio, Texas.

WASHING MACHINE—Adapted for home use, and association with a conventional laundry tub. Patent 1485774. E. L. Etheridge, c/o H. Edgett, 12 Van Dyke St., Brooklyn, N. Y.

LINER—Consisting of inner and outer spaced tubes with a cement filling, for use in deep wells. Patent 1485512. F. and I. Le Cocq, Room 307, Dakota National Bank Bldg., Aberdeen, S. D.

WIREWORKING MACHINE — For general wire working, but more particularly for producing hat frames, or the like. Patent 1486,068. A. L. Stanley Yu, c/o Henry Stipp, Ancon, Canal Zone.

POWER-TRANSMISSION DEVICE — Adapted for use in machine shops for transmitting power along different lines. Patent 1486754. J. Impellizieri, 192 Meserole St., Brooklyn, N. Y.

YARN GUIDE RECIPROCATING MECHANISM —Whereby substantially any width of cloth may be knit, the thread tube being movable any desired distance. Patent 1486780. M. Maxik, 22 W. 19th St., New York, N. Y.

APPARATUS FOR THE TREATMENT OF COAL OR SIMILAR CARBONACEOUS SUBSTANCES—Relating particularly to a coking furnace for low-temperature carbonization of coal. Patent 1486794. E. Owen, 283 Ryerson St., Brooklyn, N. Y.

PUMP-VALVE LIFTER — With means for lifting the valve by direct downward pressure without injury to the gasket. Patent 1486793. E. D. Orton, Farmersville, N. Y.

CONNECTING ROD BEARING—Which automatically takes up or compensates for wear. Patent 1486465. R. A. Smith, Box 451, Mount Pleasant, Pa.

PACKING RUBBER—Adapted to effectively engage the tubing of an oil well. Patent 1486420. E. V. Crowell, Box 1479, Sta. C, Los Angeles, Cal.

COMBINED PRESSURE REGULATING AND GOVERNING APPARATUS—Arranged to insure accurate functioning after it has been set to a predetermined pressure. Patent 1486782. J. P. Metzger, c/o Leslie Co., Lyndhurst, N. J.

Railways and Their Accessories

TRUCK—Whereby the axle bearing blocks are maintained a uniform distance from the center of the truck. Patent 1485224. H. L. Hamilton, c/o Electromotive Engineering Co., Keith Bldg., Cleveland, Ohio.

STREET INDICATING DEVICE—Which will automatically indicate to passengers on a train or car the stop to which they are approaching. Patent 1486332. J. F. Halverson, 1725 Helena St., Madison, Wis.

Pertaining to Vehicles

LOW PRESSURE ALARM—For pneumatic tires, which will give an audible signal when a predetermined pressure has been reached. Patent 1486010. W. H. Brown, 610 So. Hudson Ave., Pasadena, Cal.

BRAKE MECHANISM—By which a motor vehicle may be brought to a gradual or abrupt stop without undue strain. Patent 1485802. F. H. Morlan, Lamm Hotel, Los Angeles, Cal.

TIRE—Provided with a solid core within the shoe, the core being in sections and readily removable. Patent 1486106. F. Palombo, Stop 7, Bedford, Ohio.

NON-SKID TIRE HOOD—Which may be easily attached to or removed from a tire without special tools. Patent 1486080. M. Fink, 47 St. Nicholas Ave., New York, N. Y.

DUMPING DEVICE—For use in connection with trucks having bodies adapted to dump their load. Patent 1485631. W. C. Shea, 6200 Bertha St., Los Angeles, Cal.

CLEANING DEVICE FOR DUMP BODIES—For clearing away that portion of a load which remains in a truck body after its elevation. Patent 1485632. W. C. Shea, 6200 Bertha St., Los Angeles, Cal.

MOTOR VEHICLE ATTACHMENT—For facilitating the carrying of a number of satchels, outfits, or other objects. Patent 1486356. P. Nagle, 344 Vallejo St., San Francisco, Cal.

REAR SPRING MOUNTING—In the form of a center bearing and attaching means for springs of the so-called cantilever type. Patent 1485809. V. W. PAGE, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn.

PUMP SUPPORTING ATTACHMENT FOR VEHICLES—Which can be quickly applied to a wheel in position for convenient operation. Patent 1486798. V. G. Reed, Osmond, Neb.

TOBACCO TRUCK—Which is durable and particularly adapted for the purpose indicated. Patent 1486728. A. J. Chesson, c/o Geo. West, R. F. D. No. 6, Kenton, N. C.

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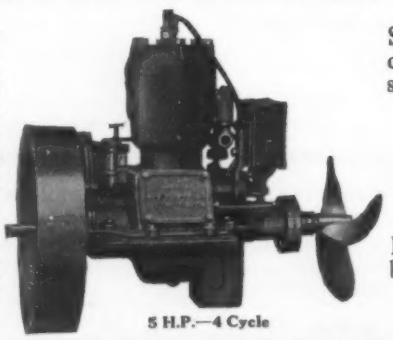

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Automotive

Liquid Oxygen, for Altitude Flights, was used, as far as is known, for the first time in this country on June 1, 1923. The problem of liquid oxygen for aircraft use is one that since the war has been engaging the attention of the aircraft interests of all nations. Its first use was by the Germans during the war. The absence of automatic control of the output, the diminution of output with altitude, the danger in case of the container overturning and spilling the oxygen in the pilot's face, and the difficulty of transporting the liquid because of its high evaporation properties were then items in the case against its adoption for general usage. But there never was a time when the advantages of its use over that of gaseous oxygen were not admissable, providing a safe and reliable container could be developed and its convenient manufacture arranged for. The apparatus made by the Bureau of Standards for the Army Air Service is a double-walled vessel with the space between the walls filled with calorox. The layer of this insulation is of such thickness that the amount of heat transmitted from the outside will evaporate the oxygen at the rate desired for respiration. The container was designed to deliver ten liters a minute, which is sufficient for two persons. When four-fifths full, the container holds a little more than six hours' supply and when one-half full, a little more than four hours' supply of the liquid. It is but logical to conclude that with progressive development future altitude records will be made with the aid of liquid, not gaseous oxygen. In view of the program of experimentation in the use of liquid oxygen planned at McCook Field, a Heylandt plant has been set up for its manufacture.—*U. S. Air Services*, 9:4, 2 pp.

Spurious Tonics for Motor Fuels.—Scarcely had tetra-ethyl lead emerged from the research laboratory, says *Chem. and Met. Eng.*, than rumors were heard of contemporary discoveries, secret modifications of the original idea; and of course all were improvements. By the time arrangements had been completed for the commercial distribution of ethyl gas, its imitations had made their appearance, and more or less open attempts were made to market them. Not all of these compounds are believed to be spurious and tests are needed to weed out the ones which are. Now comes the announcement that the Bureau of Standards is willing to take a hand in the matter. The motor fuel laboratory under Dr. H. C. Dickinson is in a position to be of service in determining the real worth of these products and quickly eliminating those whose value exists only in the prospectus of the fraudulent promoter. Dr. Dickinson says: "We may not be able to settle all the claims of these promoters, but we can quickly settle the question whether or not a given compound gives gasoline more power and eliminates knocking. We shall be glad to do our best and help all we can in testing such compounds and certifying results. We have a well-equipped laboratory and an expert staff."

Carbon Knocks.—Just what takes place inside the cylinders of a badly carbonized motor, that causes the disagreeable pound or knock which is usually called a carbon knock, has never been definitely established; but something like the following probably transpires: After the motor has run a few moments, some of the carbon deposits become red hot and part of the fuel entering the cylinders during the suction stroke is in contact with this hot carbon during the suction and compression strokes and its temperature is raised to a point where spontaneous ignition takes place before the timed electric ignition occurs. There is a consequent rise in temperature and pressure due to combustion, which is further increased by the still upward moving piston on the compression stroke. We have now present in the combustion chamber the ideal conditions for "cracking" the fuel. The fuel (gasoline) of today is rather chemically complex in its make-up and when "cracked" breaks down into more simple compounds, some of which are highly detonating and others less so. When the "cracking" occurs the less stable compounds detonate, setting off the others in the order of their stability. All this, of course, is distinguishable by the ear as a knock, or, as it is called in England, a "pink."—*Lubrication.*

Civil Engineering

Flood Reservoirs for the Seine.—Special efforts are being made in France to popularize the idea of preventing any future flooding of the Seine by the construction of vast storage reservoirs. The proposal has been meeting with increasing support on the ground that the reservoirs would afford an efficient protection for the entire valley of the Seine, while the works now being put in hand would do little more than reduce the liability of Paris to be flooded. At the same time, the reservoirs would serve for irrigation and other purposes, such as the production of energy. A further argument in their favor is that the reservoirs would be established in regions where the land is of little value. Nevertheless, there have been certain objections to the scheme, and as a reply to them a report has just been issued upon the results obtained with the five huge reservoirs which were constructed in the Miami basin in the United States after the partial destruction of the town of Dayton in 1913. It is declared that the reservoirs have rendered the town completely immune from inundations. Three reservoirs, having a total capacity of 900 million cubic meters, would, it is urged, be sufficient for the protection of the Seine valley. The cost is estimated at 680 million francs.—*The Engineer.*

How Old Are Locomotives When They Are Scrapped?—A study has recently been made on the length of life of locomotives on American railroads, from which it was found that the average age of locomotives dismantled or recommended for dismantling on the Pennsylvania Railroad is 29.4 years and on the Chicago, Milwaukee & St. Paul 35.5 years, while most of the other railroads vary between these figures. In 1870, passenger engines averaged about 66,000 pounds, while in 1920 we had passenger engines weighing 280,000 pounds. The freight engines of 1870 averaged 90,000 pounds, while heavy type engines in 1920 averaged 320,000 pounds.—*Machinery.*

A New Type of Gas Holder—the first one of its kind ever erected in America—will be built in Michigan City, Ind., this year. This innovation in gas holders is what is known as a "waterless" holder, no water being used to seal the holder, as is the practice in the type used universally in this country and everywhere else prior to the time this new design was perfected. This new type of holder has been developed in Germany, the first one being erected in that country in 1915. The type of construction is radically different from the holders in general use. Instead of sliding up and down in a huge steel frame as other holders do, this new style of holder remains stationary and a steel piston inside the shell ascends and descends as the amount of gas in the holder varies.—*Am. Gas Journal*, 120:17, 1 p., ill.

Considerable Interest is being evinced by highway engineers throughout the country in regard to a method for curing concrete pavements that will do away with the ponding and other wetting methods that are not only cumbersome but require a curing period of 30 days. By the use of calcium chloride this period may be cut to eight hours. Two and one-half pounds of the flaked or granular material (the flaked is preferred as it is more easily distributed and less easily removed by wind or rain) is applied to each square yard

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of pavement and is distributed uniformly over the surface of the finished pavement by means of a mechanical drilling device or by the use of shovels and long-handled brooms. The material is spread upon the pavement until the latter has thoroughly set—ordinarily from six to eight hours after laying the pavement. Care is taken that the material is uniformly spread and if, in the opinion of the engineer, a uniform distribution is not obtained from the shovels, a thorough brooming is required. All lumps must be broken up and uniformly distributed over the surface.—*Canadian Eng.*, 46:17, 2 pp.

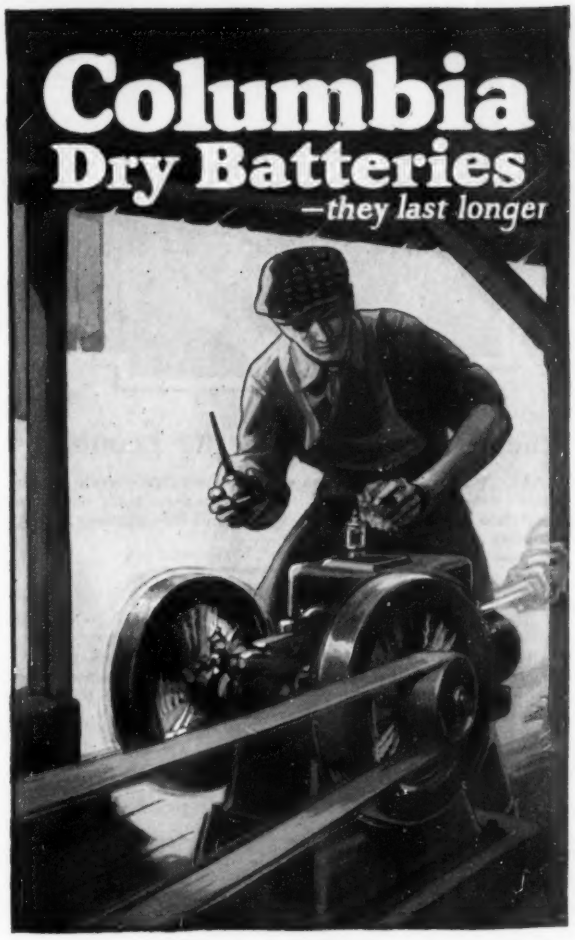
Electrical

A Floating Powerhouse was the solution of a peculiar set of circumstances existing in Longview, Oregon. Temporary power was needed during only about a year, but local conditions make the expense of erection of a land powerhouse prohibitive. Consequently use was made of a 500-ton barge made fast to the bank of the Columbia River. The installation of a 1500-kva. turbo-generator was made at Portland and the barge was towed to place at Longview. In 28 days from the time the floating plant was decided upon it was delivering energy.—*Elec. World*, 83:17, 1 p., ill.

A New Instrument Called the Aislometer has been developed for live-line insulator testing which has given very good results when applied to lines in Europe. It is simply a light, portable electrostatic indicator mounted on an insulating stick in such a way that its two terminals may be applied to the hardware (or cement) of an insulator (or shell), utilizing the part of the line voltage existing across the insulator to give an indication of its condition. As this constitutes a test at from 4000 volts to 25,000 volts per disk (in the case of strain and suspension insulators) and determines the performance of the insulators under actual working conditions, it is independent of ordinary atmospheric conditions and disturbing influences that may invalidate other tests. This is especially the case in testing Hewlett-type insulators, which usually appear good when tested with a megger, although they may be punctured. The instrument operates something like an electrostatic voltmeter, but utilizes a special construction which makes its indication adjustable as regards the voltage to ground as well as for the voltage between terminals, thus allowing it to be calibrated according to the voltage that exists on the different units of an insulator string.—*Elec. World*, 83:15, 5 pp., ill.

Cleveland's 66,000-Volt Underground Cable.—Announcement of successful tests on the 66,000-volt underground cable which has been installed at Cleveland marks a notable step in underground transmission development in this country. A few years ago all eyes were on the climb in voltage for overhead transmission, each step being hailed properly as an accomplishment of note. Predictions were freely made that the limit had been reached, first at 60,000 volts, then at 80,000, then at 110,000, but constant pursuit through research and experiment has, each time necessity for a higher voltage arose, resulted in raising the practicable voltage to meet the requirements. Today, with 220,000 volts, an operating success, thus solving the present problem of transferring bulk energy great distances, major interest in increasing operating potentials has shifted to the problem of transferring large blocks of power through the ever-widening metropolitan areas, where public sentiment, if not physical limitations, forces the transmission underground. The discussion of limits of practicable underground voltages is similar to that which occurred with reference to overhead voltages. The development will doubtless be a step-by-step one, as it was in the other case. The present increase to 66,000, practically a doubling of any successful existing practice in this country, is therefore a substantial accomplishment.—*Elec. World*, 83:14, 5 pp., ill.

The Klydonograph is an instrument for measuring and recording high voltage surges in transmission lines. There is, says *Elec. World* (83:16, 5 pp., ill.), plenty of evidence that surges of considerable magnitude appear on extensive transmission systems. Study of these surges by means of a spark gap has been customary but a sphere spark gap has a considerable time lag. The klydonograph is based on an old principle making use of the Lichtenburg figures. Dr. Lichtenburg found in 1777 that on discharging a condenser across a spark gap on a terminal in contact with an insulating plate placed between this terminal and a ground



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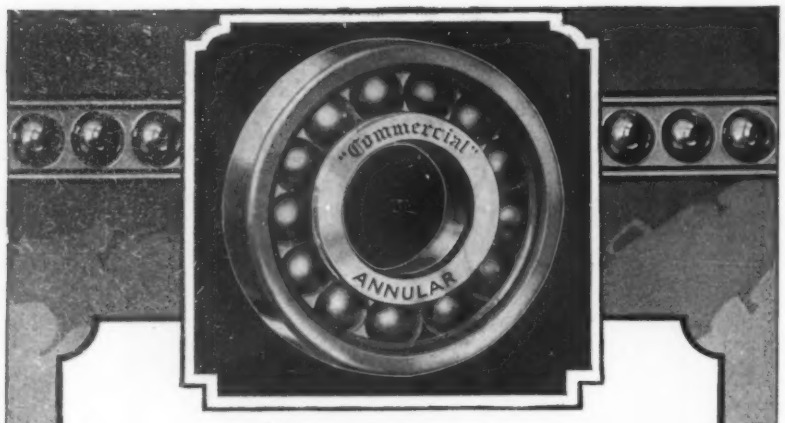

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plate, and then sprinkling powder on the plate, the powder would arrange itself in a very peculiar figure. The figure produced by a positive charge was entirely different from the negative. It was later found that on replacing the insulating plate with a sensitized photographic plate, figures very similar to those of Lichtenburg were produced. In using the instrument, if the voltage is in the form of a surge the figure on the photographic plate will show indication whether it had an abrupt or a tapered front, and whether the surge was positive or negative. Again, if the surge was alternating the figure will differentiate between it and the unidirectional surges. The diameters of the figures give a measure of the magnitude of the surges; while the figure for a positive surge is quite a bit larger than that for a negative one.

Great Improvements and Extensions have been accomplished in recent years in the available methods for obtaining high values of continuous voltage. Chief among them may be mentioned the rectifying vacuum tube with auxiliary capacity and inductance and the standard continuous-current generators with specially designed compensation permitting voltages up to 15,000 in a single armature. These methods have proved of great value in the testing of dielectric strength of cable insulation, in the operation of Roentgen ray tubes and in various problems of experiment and test. In the last-named field, however, it has come to be realized that in certain cases the methods mentioned have serious limitations on the ground of constancy and uniformity. If any appreciable current is taken in the vacuum-tube method, serious voltage pulsation is avoided only by large addition to the auxiliary capacity. Every generator has a commutator ripple in its voltage, and undercurrent is subject to irregularities due to brush contact. This type of disturbance is present in both the methods and may cause great difficulty in investigations of precision, in which it is necessary to measure very low values of current at high voltage. So far the high-potential battery is the only satisfactory source for these refined studies. The expense and inconvenience of the battery, however, give emphasis to the need of further improvements in the sources of high continuous potential.—*Elec. World.*

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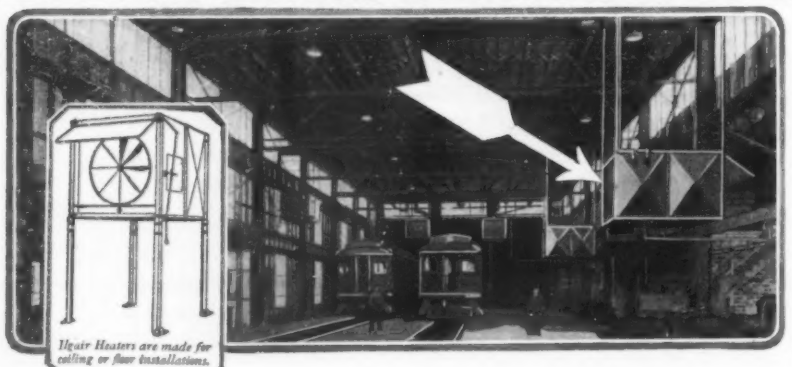
General

Potash.—Previous to 1914, Germany supplied practically all the world's potash. All production was pooled and was distributed by the Kali Syndicate, whose policy was largely dictated by the government. As a result of the war a considerable number of the German mines were secured by the French through the acquisition of Alsace Lorraine. The French immediately entered the American market with their product. In the meantime a great number of American producers had sprung up to meet the demand for potash, as all importation had ceased with the British blockade of German ports. Germany re-entered the field, and German producers, as well as France, cut the price at the seaboard below the delivered cost of American producers. As a result all American plants closed down with the exception of one company, which is now producing at the rate of about 3000 tons per month of a high-grade muriate of potash, testing 59.5 per cent actual potash (K_2O), which is about 10 per cent higher than the European muriate. This high analysis enables the American company to compete.—*Eng. and Min. Jour. Press,* 117:14, 2 pp.

Iodinizing Water to Prevent Goitre.—The consensus of opinion brought out at the recent Ohio Conference on Water Purification by a discussion on introducing iodine into public water-supplies in parts of the country where goitre is prevalent was against the practice. Iodine taken into the human system in any form in small amounts regularly constitutes a preventive of simple goitre. Use of iodine is not injurious if taken in small amounts, for example 10 to 20 mg. per week. Iodine does not aggravate cases of simple goitre already developed but on the contrary is a marked benefit in a large percentage of instances. For goitre prevention iodine is best given individually through specially prepared chocolate-covered tablets known under the trade name of iodostarin, these tablets being of 10 mg. content. Medical authorities who have made a study of goitre prevention are inclined to recommend that manufacturers of common table salt be compelled to leave in the salt prepared for usual domestic consumption a "normal" amount of iodine. This amount



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has not yet been established but is being investigated. Application of iodine in any form to drinking water constituting the public water supply is not advisable, being rather wasteful; furthermore the practice is undesirable from a public policy standpoint. In other words, the public would not favor the idea of adding prophylactic ingredients to the public water supply although it might be in entire accord with retaining "normal" iodine content of salt.—*Eng. News Record.*

An Odd Problem is presented in *Comp. Air Mag.* (29:4, 5 pp., ill.) in an interesting article on the scrapping of naval vessels by scrap-dealers, or as suggested by the writer, "secondary-metal engineers." How is it possible to scrap all of a steel battleship? It is not hard to visualize the steps by which a capital ship is cut down progressively from masthead to just above the water, because as the superposed weight is lightened the hulk rises surfaceward; but even at this advanced stage of breaking up there still is left possibly 1000 or more tons of metal forming the remnant of the craft's bottom. This portion of the hull is watertight and floats although the rim of this elongated dish projects but a few inches above the surface of the river. The problem is to salvage the metal and not to allow it to fill and sink to the water bed. It is more than likely that the disposition of such a hull section could best be accomplished by grounding it broadside with the beach at high tide and by severing such of the structure as continues submerged at low water by recourse to the subaqueous metal-cutting torch. Of course, the ordinary oxy-acetylene torch can be utilized in cutting any of the steelwork projecting above the water.

You Probably Use Porpoise-Jaw Oil.—From the spongy fat in the jowls or jaw pans of the porpoise is extracted an oil which is peculiarly fitted for the lubrication of time-marking mechanisms. Nut oil, bone oil, seed oil, and mineral oil have been tried in turn for this exacting service, but none of them has proved entirely satisfactory. Therefore, porpoise-jaw oil still stands apart because of its admirable and somewhat unique qualities. The capturing of the porpoise and the refining of its oil constitute a modest but nevertheless a vitally important industry described in *Comp. Air Mag.*, 29:4, 4 pp., ill.

Is Ammonium Nitrate an Explosive?—The disastrous explosion at Nixon, N. J., on March 1, 1924, the most recent of a number involving ammonium nitrate, has served to emphasize again the need for more detailed information in regard to the explosion hazard of ammonium nitrate and its mixtures. This subject is discussed in *Chem. and Metall. Eng.* (30:16, 5 pp.), with the conclusion that the observed velocity of detonation of about 2500 meters per second removes all doubt as to the character of ammonium nitrate as a brisant explosive. It is true, it is insensitive and difficult to detonate and cannot be put in the same class as the explosives that are suitable for practical blasting, since it propagates the detonation only under certain conditions—for instance, in large masses, large diameter or strong confinement—whereas a practical blasting powder must propagate the detonation even with a small cartridge diameter and comparatively slight confinement. On the other hand, the differences are more of degree than of type, as even unconfined ammonium nitrate can be detonated with certainty, although with greater difficulty than when confined, provided that the initial impulse is sufficiently strong. Since this is the case not only for specially prepared (thoroughly dry, ground or finely crystalline) ammonium nitrate, but also for the raw, somewhat moist, technical product, blasting must not be resorted to in order to loosen caked heaps of this material, as this could easily result in the explosion of the entire mass. In fact, such an explosion occurred two years ago in a plant of the Lignose-A.-G. through gross carelessness.

Calcium Arsenate is a youthful chemical product, but during the short period of its existence the development of methods of production have made rapid strides. Whereas it required a plant costing $250,000 for its manufacture, we are now told by B. R. Coad, Government expert in charge of boll weevil control investigations, that there is being worked out a process by which calcium arsenate can be produced in a plant costing very much less. The greatest obstacles to this goal have been removed and there remains only the working out of the mechanical problems, which may require months or a year. Speaking to a committee of Congress, Mr. Coad said he expected to see

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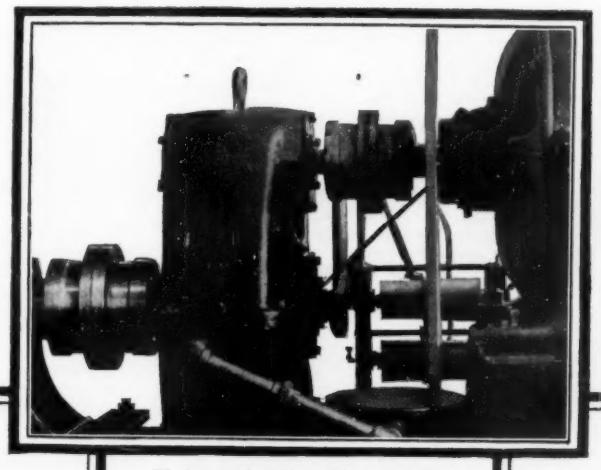

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calcium arsenate produced at a price that it could sell at six or seven cents a pound instead of an average price of 16 cents at which it sold to the farmer last year. The manufacturing process which Mr. Coad announces will cheapen calcium arsenate was confronted with a puzzling difficulty until the airplane gave the clew to its solution. The calcium arsenate stuck to the sides of the mill in grinding. The airplane experiments in which like electric charges were employed to disperse this chemical after it was released from the plane had demonstrated that calcium arsenate could be electrified. This knowledge was applied to the mill difficulty. A positive charge of electricity was given the mill whereupon the calcium arsenate did not stick to the sides, indeed could not be made to adhere.—*Mfrs'. Record.*

'Sweden Wins—We Lose.—In a recently issued pamphlet dealing with the iron and wood industries of Sweden, a few principles are stated which are of considerable significance to American engineers and industrialists. To quote from the publication in question: The leading industries of Sweden are nowadays those based on the exploitation of the forests. The annual value of the products turned out by Swedish sawmills exceeds $400,000,000, and this value is steadily increasing as less wasteful processes of production are being introduced. Until a short time ago the United States was a strong competitor in the Mediterranean trade, but the reckless cutting of timber, without replanting, has rapidly exhausted the supply available for export and turned that market over to Swedish dealers. During the last few years, however, a wonderful interest in reforestation of the denuded areas has developed in the United States, but it will take a century at least before American timber exportation once more can become a factor in the world market. When the coal, the ores, and the oils of the world are exhausted, Mother Nature will still grow forests of magnificent quality on Swedish soil, and that is the reason why Sweden and its wood industries may confidently look forward to a bright and prosperous future, and why Sweden one day must become one of the most important factors in the world's trade. —*Mech. Eng.*

Revival of German Shipping.—At the end of the Great War German shipowners and naval architects were assigned the task of reconstructing a mercantile marine which would at least be able to undertake the most urgent transport for their country. This task has been solved in five years' work, and is now practically at an end. There was an opportunity as never before to build a modern and economical transport fleet; but, looking upon the result there are as a whole not so very many new features in it as might be supposed. The work was urgent: no time could be lost in experiments and trials. Consequently owners kept in the main to their usual types of ships and engines, applying, of course, modern technical experience. Thus the major part of the new boats is driven by superheated triple-expansion steam engines. The number of vessels provided with geared turbines is not so very large. Oil burning under boilers has been taken up in a number of the larger vessels in the Transatlantic service, and their service experiences have been good. Diesel engines were but very slowly introduced—an astonishing fact, considering that German oil engine builders were ahead before the war and were able to collect a lot of very valuable experience concerning the oil engine during the war.—*Shipping World.*

Industrial Progress

Standardization in Germany.—Practically every important manufacturing concern in Germany is participating in the industrial standardization program of that country. More than a thousand German companies have actual standardization organizations within their own works. The extent to which industrial life in Germany has been coordinated is shown by the fact that more than 700 German national standards have been adopted, including standards in the machine shop industry, such as standard shaft diameters, tapers, sizes of keys, threads, fits, measuring instruments, gages, specifications for materials, machine handles, ball bearings, journal bearings, gearing, and even sizes of drawing paper.—*Machinery.*

Power Presses are now being used successfully in the production of many parts that were formerly believed to be too complicated to be made with any type of press die. Less complicated parts that in the past have required the use of several separate dies are now made by a series of operations in one die that produces a finished part at each stroke of the press.—*Machinery.*

Ford has upset another precedent. By simply applying common sense in the minimizing of waste heretofore regarded as more or less inevitable in the supplying of wood parts for automobile bodies, he is reported to have demonstrated savings of 35 to 50 per cent. The essence of his plan is simply to saw up the logs, as they come from forests which he controls, in such a way that waste is reduced to the lowest feasible amount. Instead of virtually throwing into the discard parts of slabs cut from the log in order to get boards with parallel edges, the parts of the body which would in any case be cut from the boards are marked out on the untrimmed slabs, following the irregular contours to a large extent, so that ultimately little except extreme edges is wasted. Parts, such as the swell at the butt, and branches not less than four inches in diameter as well as logs which formerly were regarded as too crooked to be cut to advantage, heretofore largely wasted, now are used to good advantage.—*Automotive Ind.*, 50:16, 2 pp., ill.

Conversion of Alunite to Aluminum Sulfate.—Metallurgists of the Department of the Interior, attached to the Pacific Experiment Station of the Bureau of Mines, Berkeley, California, have conducted successful small-scale tests on the bureau's new process for conversion of alunite, a mineral consisting chiefly of potassium and aluminum sulfates, into alum and aluminum sulfate. The apparatus constructed for these tests has a capacity of 100 pounds of alunite per charge. After the alunite is rendered soluble, the solution is treated for potash alum, and a good grade of iron-free alum is obtained by direct crystallization. Further work is being done by the Bureau of Mines investigators to develop the procedure for recovering alum to still higher efficiency, and for recovering aluminum sulfate after the alum has been removed. When these details are worked out, a plant having a capacity of one ton will be erected. The chief object of this work is to develop a simple method of preparing aluminum sulfate solutions free of impurities, such as iron, from impure clays for clay-like deposits, and thus provide a much-needed cheap process for the manufacture of pure alum and other aluminum salts, which now cost twice as much as the less pure salts.

The High Regard in Which British Scientists Hold American Research as now conducted is a matter of recent testimony, says *Iron Age*, in an editorial. In his presidential address before the Institute of Metals, briefly reviewed in the *Iron Age* last week, Professor Thomas Turner quotes from Sir J. J. Thomson as to the scale on which industrial research is conducted in the United States. Citing among others the extensive laboratories of the Western Electric Co. and the General Electric Co., with their large staffs, Professor Turner said: "In many cases much of the work in hand is as purely scientific in type as that which is conducted at the Cavendish laboratory at Cambridge. . . . They (the investigators) appear to be thoroughly interested in testing theoretical views and the general tone is similar to that of an English university." The large industrial companies maintaining such organizations, while they are following the promptings of enlightened self-interest, are at the same time adding to the common knowledge and thus to the general welfare. More and more, to their credit be it said, they have been willing to make public their findings.

Accidents Steadily Increasing.—Some of the unfortunate effects of the sudden curtailment of expenses which came in 1920 in many industries are now being shown in the statistics of industrial accidents in the United States. During the war period and for a short time thereafter large amounts of money were expended on personnel and safety work, but when cost reduction became necessary it was not always wisely carried out. Safety organizations suffered and precautions against accident diminishe .. It is now estimated by the National Safety Council from statistics collected from States, insurance agencies and industrial companies that 1923 will show an increase of 20 per cent in industrial accidents. Reports from nine States show more than 500,000 accidents, an increase of about 100,000 over the previous year. The total for last year is estimated at 3,000,000 accidents, of which 23,000 were fatal and 115,000 caused per-

(*Continued on page 56*)

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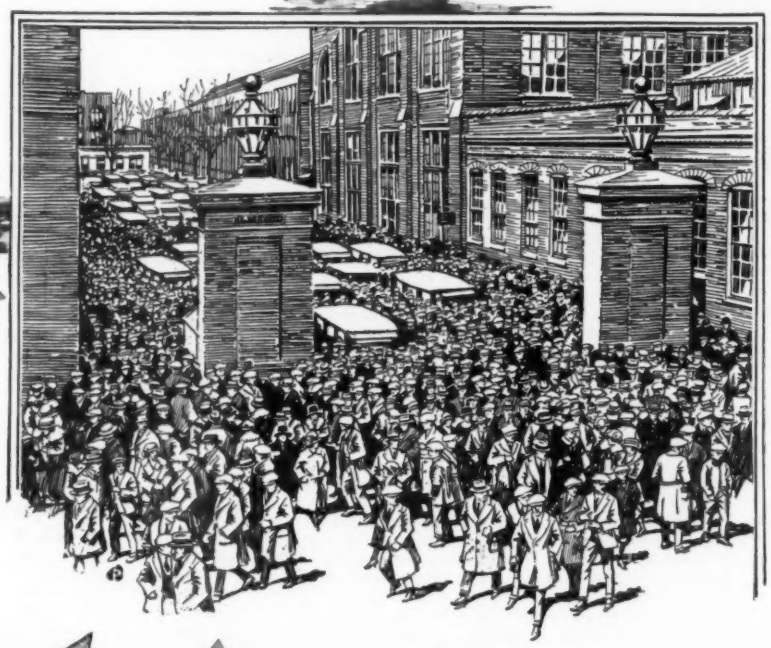
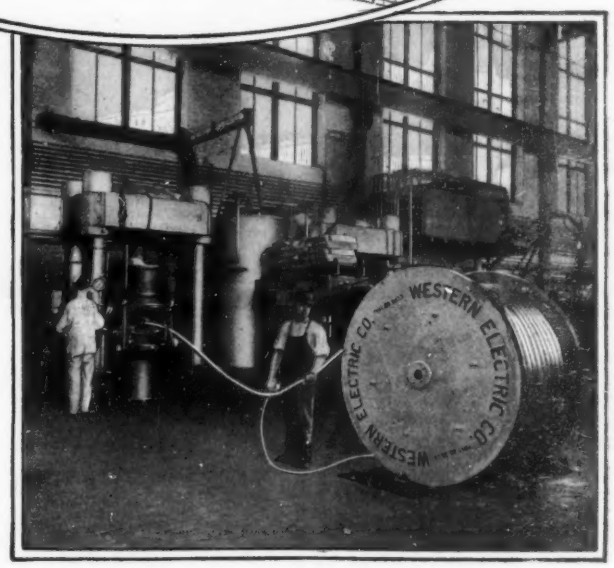


As building progresses, men and women by the thousands—in truth a cityful as at Hawthorne — will be busily employed here making telephone equipment.



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manent disability. The total cost is estimated at $1,000,000,000.—*Iron Age.*

Gas in the Year 2000.—An awakened public conscience first put a stop to the barbarous practice of burning raw coal, with the consequent waste of the valuable by-products, such as drugs, fertilizers, tar, carbon bisulfide for dissolving rubber, ammonia, dyes, including indigo, moth balls, photographic chemicals, sulfocyanides, carbon for electric arcs, explosives, perfumes derived from tar, coke, etc. Today the large gas plants engaged in reclaiming these valuable by-products of coal are mute but magnificent evidence of the lack of wastefulness in these later days. The fact that our coal mining is all done by machinery today with mines so arranged that loss of life is almost unknown also shows a wonderful step in the march of human progress. Our radio equipped mines that seem so simple today were in 1924 only visionary dreams in the minds of scientists. The work one white uniformed man today controls by the simple turning of a switch took thousands of coal-discolored men to accomplish seventy-five years ago. (*Gas Jour.*, 120:13.) This is not by Mr. H. G. Wells, but it is a prophecy put in the form of reminiscences written by a man of 76 who is supposed to have been born in 1924. To those of us who are inclined to be amused at the crudities of life in the days of our grandfathers and boast of our refined civilization it is food for reconsideration.

Platinum has long held its place as an acid and heat-resisting material in chemical laboratories; as a catalyser to speed up chemical processes that are too slow for commercial purposes; as leading-in wires for electrical bulbs; and of late years in the manufacture of jewelry. The last-mentioned use is rather a strange one, as platinum is not at all a beautiful metal. It must owe its vogue either to its hardness and permanence as compared with gold, or perhaps to the fact that weight for weight it costs five to six times as much as gold. The demand for platinum for this purpose has so increased the price that a rather serious situation is created for those arts in which this metal is indispensable. Thirty-five years ago, the price of platinum was less than that of gold. Its present price places a severe tax upon assayers and analytical chemists, in the equipment of whose laboratories platinum in the form of crucibles, electrodes, etc., plays such a large part. It is thought that the recent discovery in South Africa in the Waterberg district about 100 miles north of Johannesberg may relieve the situation.—*Can. Min. Journal.*

One Billion Minutes have elapsed since the birth of Christ, but 1,560,000,000 barrels of cement were used in the United States in the past twenty years, according to a statement made by B. F. Affleck, president of the Universal Portland Cement Co. before the recent twentieth convention of the American Concrete Institute, an organization of architects, engineers, contractors and other builders. The speaker declared, in illustrating the enormous amount of concrete used, that in the past twenty years this industry might have supplied material for a solid concrete monument similar to the Washington monument, which would have been 1645 feet square at the base and 16,529 feet high. Even if it went down to bed rock for a foundation, the question was raised whether any spot on the earth could sustain so heavy a concentrated load. "There were 1,560,000,000 barrels of cement used during this period," Mr. Affleck declared. "And as cement is used for making concrete and as concrete is permanent, nearly all this concrete still continues to serve a useful purpose. Unlike most products it is used but not consumed. Similarly, all the wages, labor, quarrying, transportation and financing represented in concrete construction become permanent contributions to the country's social and industrial progress."

A New Fence Fabric.—All chain link fence fabric is woven on looms. As it comes from the looms, the fabric constitutes a loose net work which, when stretched, forms a diamond mesh fence fabric. Heretofore, when attempts were made to galvanize fabric after weaving, this loose fabric, after being dipped in hot zinc, would freeze (or solder) at the intersections or loops, when cooling. The frozen loops, because of the brittleness of the zinc, were easily broken in handling. Consequently, wherever breaks occurred, the metal beneath was immediately exposed to rust action. The result was a discouraging disappointment to fence manufacturers. Up to now, the only alternative for this difficulty was the use of commercial wire, galvanized before weaving. However, because of the bending and twisting of the wire during the process of weaving, it was necessary that the galvanizing be applied very lightly to avoid scaling or chipping off during fabrication. Even then abrasions to this light galvanizing could not be avoided. Rust immediately attacked the metal where breaks occurred and the elements soon ate through the remainder of the light galvanizing. The only remedy known to fence manufacturers for this fault was dipping the fabric in paint, lacquer (or gum base oil) at the time of manufacture, or painting the fabric periodically after the fence was erected. At best painting was only temporary. A process for hot-dipping after weaving has been invented and fence of this sort is being manufactured.

New Grain Elevators for South Africa.—With the rapid development of grain-growing in South Africa the old practice of handling individual shipments in bags is giving way to the elevator system, in which the grain is handled in bulk for export. To meet this development, two terminal port elevators and thirty-four country elevators are being built and will be operated by the South African Railways and Harbors Administration. The two terminal elevators at Durban and Cape Town have capacities of 42,000 and 30,000 tons respectively, while the capacities of the elevators at country stations range from 1800 to 5800 tons, with an aggregate of 109,200 tons. These works are expected to be completed by the summer of 1924 at an estimated cost of about $10,000,000. Until 1917, the annual grain export did not reach 500,000 bags, but in three years since that time it has exceeded 4,000,000 bags and the export for 1923 was estimated at more than 6,000,000 bags. Further, it is estimated that after paying interest and operating expenses of the elevator system there will be a saving of $2,500,000 in the annual expense of handling and transporting grain.—*Eng. News Record.*

No Country in the World has as highly developed a system of modern transportation as the United States and still the industrial development of the country is moving forward at a more rapid rate than the transportation facilities. In the last ten years the number of freight cars has increased by 23 per cent and the aggregate tractive power of locomotives by 41 per cent, but the country is offering the railroads 60 per cent more traffic to haul.—*Machinery.*

Soft Metal Parts of brass, bronze, aluminum and other metals have been produced for some years by hot-pressing in dies used in friction screw or percussion presses, but it is only recently that steel parts have been manufactured in this country by this process. That the process would be practical was apparent from the fact that steel parts of an endless variety had for years been satisfactorily hot-pressed in European countries. Briefly, the process consists of heating slugs of steel to about 1800 degrees Fahrenheit and then pressing them to the desired shape in tungsten steel dies having cavities corresponding to the outside of the desired part. The steel slugs, of course, must have about the same cubical contents as the pressed part. An important application of the hot-pressing process is in the production of chrome-vanadium and chrome-nickel steel gears for automobile transmissions. The gears, with the teeth formed, are made at one blow on a percussion press which delivers a pressure of 400 tons.—*Machinery*, 30:6, 2 pp., ill.

Mechanical Engineering

The Largest Ship Driven by Oil Engines instead of steam engines or turbines is now under construction in England. It will be the first transatlantic passenger liner provided with Diesel engines, and when completed will enter the service of the Swedish-American line. The engines will develop 16,000 horsepower.—*Machinery.*

A Powerful British Locomotive which has just been ordered is to weigh 163 tons. It has been customary in this country to regard European railway rolling stock as toys. This is by no means true any longer. Many fairly heavy locomotives are now seen in England and the continent; while their short hauls would not warrant the use of our 400-ton engines. The new engine will be of the Garratt patented articulated type.

(*Continued on page 58*)

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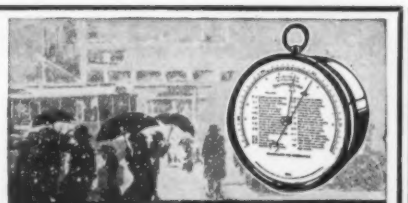

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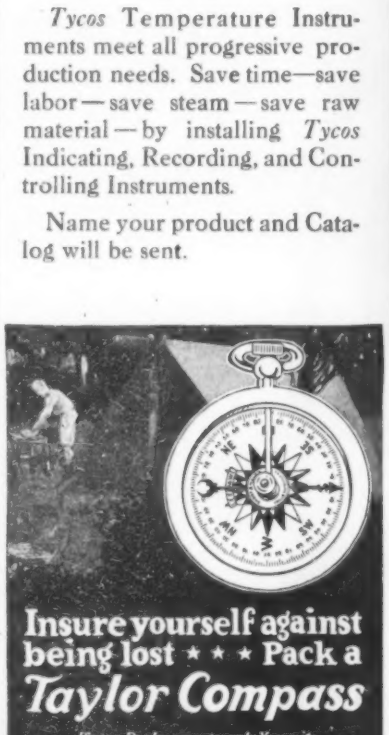

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Scientific American Digest

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which comprises two locomotives with one common boiler. The design has been specially made in order to meet the arduous service conditions of the railway company's Worsborough line. This line is a mineral traffic line, and between Wombwell and Penistone it has in the past often proved necessary to attach several locomotives to one train. With the new Garratt engine, considerable economy of working is expected. The following are some of the principal dimensions of the new engine: Total wheel base 77 feet 6 inches; grate area, 56 feet; total tractive effort, 62,650 pounds; with a total weight in working order of 163 tons. The engine will have four cylinders, each of 21 inches in diameter, and a piston stroke of 26 inches.—*The Engineer.*

Metallurgy

Acid-Resisting Alloy.—An alloy which has resisted, when subjected to tests, the action of 25 per cent nitric acid for twenty-four hours without a measurable loss in weight, consists approximately of 6.5 per cent copper; 1.0 per cent of manganese; 1.0 per cent of silicon; 2.25 per cent of tungsten; 1.1 per cent of aluminum; 0.8 per cent of iron; 4.75 per cent of molybdenum; 21.1 per cent of chromium, and 61.5 per cent of nickel. The melting point of the alloy is approximately 2370 degrees Fahrenheit. When thoroughly liquid, the alloy pours readily and fills the mold perfectly, but the freezing point is so quickly reached that feeding of the casting from risers to make up for shrinkage is practically impossible, while the shrinkage is so excessive that cracks and hollow spots are very difficult to avoid. The material can be machined in a lathe about the same as tool steel. The tensile strength of the cast metal is about 50,000 pounds per square inch.—*Machinery.*

Chromium Plating for Corrosion Resistance.—Plating with metallic chromium is a process now in that stage of development where it is known to be practicable but is not yet widely adopted. It is still being developed, but it cannot be long before such an efficacious protection against corrosion becomes a familiar device of the chemical engineer. It is well known that many of our best corrosion-resisting metals contain large percentages of chromium. This is not a coincidence; their efficacy is due to a surface film made up largely of chromium oxide, which has a most remarkable combination of properties. This film is thin, invisible, continuous and non-porous. It adheres tightly to the metal and it has almost the same coefficient of expansion as the metal itself. In addition to being unaffected by most oxidizing agents, this oxide has the advantage that it is not reduced by such molten metals as tin and zinc. It is not surprising therefore that chromium plating, which acquires a surface film made up almost entirely of chromium oxide, should provide excellent protection against corrosion.—*Chem. and Metall. Eng.*, 30:16, 2 pp.

Oxygen-Enriched Blast.—A patent has been issued in the United States to Claude C. von Nuys for a novel process whereby a blast enriched in oxygen and free of moisture is provided for metallurgical use. The proposal is to refrigerate the whole of the air supply for the blast in the excess cold from a liquefaction system, thus removing water. Part of this dried air is then liquefied to the point where nitrogen is condensed, thus providing for the enrichment of the blast. The condensed nitrogen is then used expansively to create power in prime movers of suitable types, thus providing power necessary for the refrigeration.—*Can. Min. Journal.*

Crucibles from Which Platinum Can Be Successfully Cast are now being made at the Bureau of Standards of the Department of Commerce. Thorium or zirconium oxide is used. It is ground to a powder and mixed with water and gum. Then it is poured into a plaster mold which absorbs the water from the outside of the mass of slip. When the part thus dried is thick enough the liquid interior is poured out and the crucible dried and fired. Platinum is melted in an induction furnace, wherein a high frequency current in an outer coil induces strong eddy currents in the platinum itself and these currents heat the metal. The metal is placed in a crucible which must be able to stand the very high temperature produced, but the rest of the furnace is comparatively cool. The melting point of platinum is 3200 degrees Fahrenheit.—*Brass World.*

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A New Miracle Mineral

(*Continued from page 7*)

after a large number of successive expansions and contractions, strains are set up which differ from those that crack glass in cooling, only in that they are much less intense. They are not without effect, however, and in time the fork is no longer true to its original pitch at any temperature, having become permanently distorted and hence having acquired a new period of vibration. We are not accustomed to a transparent tuning fork, but that is of no consequence at all. A quartz fork gives a singularly pure tone, vibrates for a longer time than most metal forks, and remains permanently true to pitch.

Another instance of similar sort is found in the standard of length. National and international master gages are today stored under the most elaborate precautions, and used at carefully controlled temperatures. Again the sight of an apparently-glass meter stick is a bit startling, but is justified by the fact that such a stick, over a wide temperature range, is practically unaltered in length and will stand a great deal of rather rough practical use without becoming altered. One of the foremost American authorities on weights and measures looks for the complete replacement of steel rod and block gages by quartz.

The clock gives us yet another place where near-glass may replace metal. One of the major difficulties of keeping true time lies in the fact that the period of a pendulum is a function of its length, so that the clock runs faster as the weather gets warmer and the bob longer. A pendulum of quartz would stop this.

A very slight exercise of the imagination is sufficient to conjure up a great many possibilities depending upon various properties or combinations of properties of the new quartz. With no pretense of being exhaustive we mention one or two of these. Quartz is chemically less active than glass, for the very good reason that it is of one chemical substance throughout. To attack a vessel of silica an acid must attack silica; to attack one of glass it may just as effectively attack lime, or lead, or iron, or any other of numerous constituents. And the impossibility of damaging a quartz vessel in the fire simply adds to its advantages for laboratory use, and indicates that to a considerable extent it may replace platinum here.

Quartz is the best known electrical insulator. Insulators suggest spark plugs. Of course the cost will be quite too high for ordinary use in this field. But one of our leading automotive engineers is moving heaven and earth to get the Lynn engineers to make him up a few sets of experimental plugs of quartz, so that he may see his sparks in action and study their behavior visually. This very delightful sample of the combination of two properties in a totally unexpected application may well stand as the climax of our story.

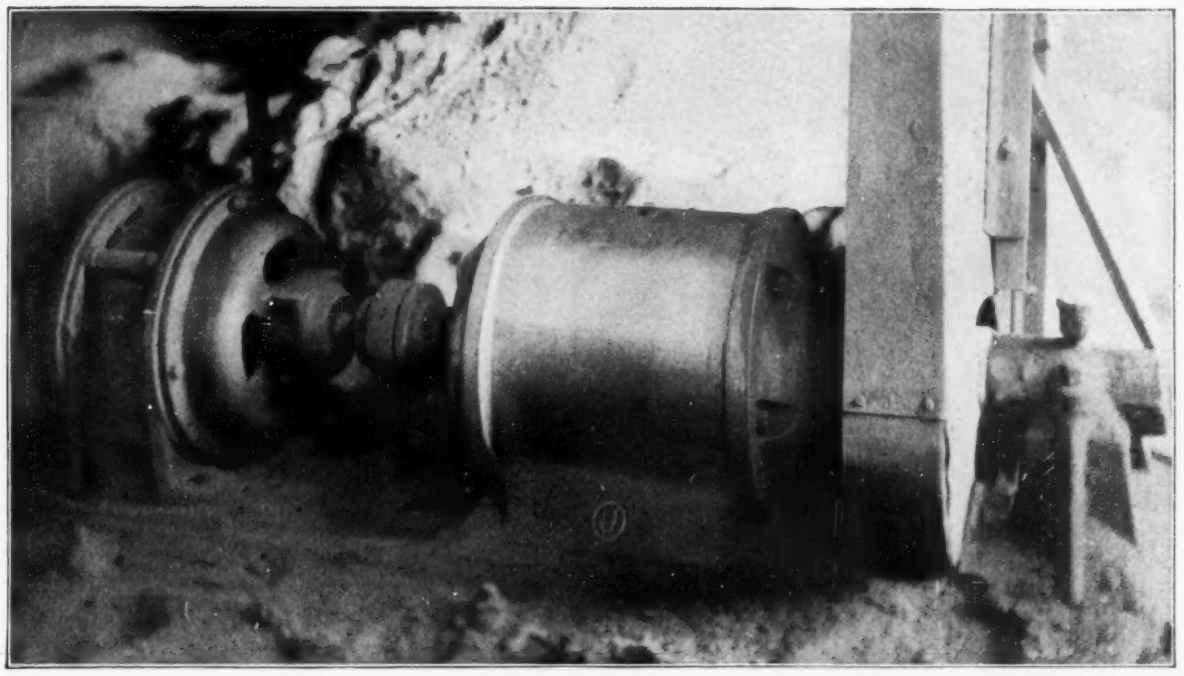
Cross-Examining the Automobile

(*Continued from page 9*)

features, such as details of equipment, brakes, and springs, receive more concentrated thought. This chart serves to guide the research men in their work. It is a sort of case history, so to speak, indicating where the automobile doctor's attention should be directed. It is highly interesting to note how the research man studies the wear and tear in the automobile. The car, following the spell of road work, is taken down piece by piece, and carefully studied to see what would happen in the hands of the average automobile owner. Even the crankshaft is sawed in half and treated with etching acid, which eats between the fibers and discloses the causes of probable breakdown. The acid attacks the structure between the fibers but not those parts possessing their original fiber grain relations, and the result is very much like a piece of coarse-grained wood. Such studies of crankshafts lead to better designs and more suitable alloys.

Winter Driving Conditions in July

It is essential to know what a car will do in zero weather as well as in mid-summer; so, a very necessary part of the laboratory is a gigantic ice box, large enough to accommodate a car, in which are tested carbureters, starting systems, oiling, cooling and other things that cause the motorist trouble in winter. The research man, even though it be July, can go right ahead with winter tests. A car is run into the ice box, the exhaust is connected to a hose which leads outdoors so as to remove the dangerous gases, the re-



Jones Speed Reducer driving Measuring Machine in Coal Briquetting Plant. Motor speed 855 R.P.M.—Ratio 28.5 to 1—Final speed 30 R.P.M.

Unaffected by Atmospheric Conditions

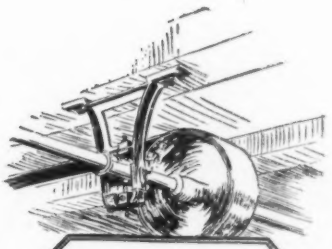
In this Coal Briquetting Plant Jones Speed Reducers are giving continuous satisfactory service. They are unaffected by abrasive dust and dirt so ruinous to exposed appliances formerly used to reduce speed.

Think what it means to this plant to be able to do away with the old fashioned open transmission units; to have no vexatious shut-downs or delays, to eliminate costly repairs and high maintenance expense; to save installation space; to obtain greater power efficiency and to avoid all danger of accidents.

When once installed you can forget the Jones Speed Reducer. The enclosed gears operate in an oil bath. The only attention required is occasional lubrication.

Adverse conditions only emphasize the advantages of Jones Speed Reducers. They are used in many industries—for many different purposes.

We will be glad to send you a book on speed reduction. It may suggest a solution of some bothersome problem. Simply ask for Book No. 26.



Power Transmission Service

IN addition to spur and worm gear speed reducers, we manufacture a complete line of power transmission appliances—hangers, pulleys, couplings, pillow blocks, friction clutches, ball-bearing loose pulleys, safety collars, etc.

The service of our engineers is at your command. Their experience may prove very helpful. We will be glad to have you write us.

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Jones Speed Reducers

and Power Transmitting Machinery

JONES FOUNDRY AND MACHINE CO. *have our endorsement. In dealing with them please mention* SCIENTIFIC AMERICAN.

Here's why I want Sterling Wheels

Not long ago a certain plant decided to settle the matter of grinding wheels. Four different makes of wheels were given test runs. Following the tests the superintendent wrote the following memorandum to the purchasing agent:

> In the past six months we have had sample wheels for trial from . . . . . I cannot recall the time on two of these but one of the others had two wheels that ran 122 hours grinding transmission cases and manifolds. On this same work Sterling Wheels ran 166 hours.
>
> I recommend Sterling Wheels for three reasons:
>
> First.—The life of the wheel.
>
> Second.—The cutting quality which means a whole lot towards production.
>
> Third.—The service that we have gotten in the past thirty days. We have never gotten the service from the other three companies that we have from the Sterling Company.

Read again what this superintendent says. It is exactly what we intended to make and have made Sterling Grinding service mean—longer life, better cutting quality, and a satisfactory service to the user.

And back of the fulfilment of this ambition stands the Sterling Grinding Engineer bringing to bear in each instance his broad knowledge and experience to the end that you obtain more and better grinding. Call him in. Talk to him. Let him show you why you, too, will want Sterling Wheels.

The Cleveland Stone Company
Artificial Abrasive Division
Cleveland New York Boston
Factory: Tiffin, Ohio Office: Cleveland, Ohio

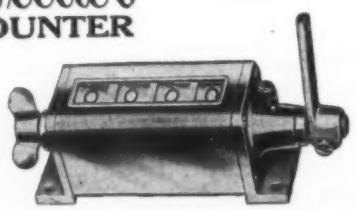
STERLING ABRASIVES
AND STERLING GRINDING MACHINES

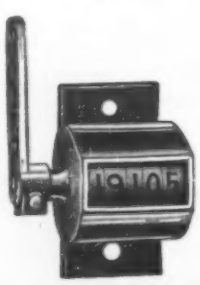
Must Be Run Well when Run at All

Fast work—cheap production—can be made almost as automatic as the functioning of your machine. A counter brings the output more in accord with the *capacity* of the machine; places that obligation on the operator. The registering of high-rate production becomes a regular part of your machine's operations, when equipped with a

Veeder COUNTER

The large Set-Back Revolution Counter at right is less than ½ actual size. The small Revolution Counter below is shown nearly full size.





The Set-Back Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures, as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

A VEEDER will make any machine produce more cheaply—if it's up to the operator or mechanic. Write for the Veeder booklet; 80 pages on counters—for ALL machines.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

search worker dons his heavy sweater and cap and ear laps, and everything is set for a winter test.

And in this ice box feature we have the key-note of the laboratory, namely, the simulating and speeding up of actual conditions under careful supervision. The wear and tear that takes place in a year of ordinary life can be duplicated in the laboratory in a day or a week or a month, as the case may be. Remember, always, the research laboratory formulates the yard sticks.

In every corner of the laboratory the writer found ample evidence of this yard stick motif. Here could be seen the shaking table—a loosely hinged platform on which was strapped a storage battery to be shaken and bounced and swayed in the most violent manner, hour after hour until something happened. Perhaps each hour of this gruelling test represented a day or a week or a month of actual jouncing over ordinary roads, but at any rate here was the research yard stick at work.

Again, in another corner, there was a typical collection of dashboard instruments, such as the speedometers, ammeters, oil-pressure gages, and clocks, mounted on a board which was treated to a periodic lift with a continuous vibration and a sudden and none-too-gentle fall. Here again, months and even years were being condensed into hours.

Once more, on a table in one of the numerous departments the writer came across queer little metal bellows—a whole battery of them—which were being squeezed and expanded, squeezed and expanded, by means of light shafting and cams driven by an electric motor. A counter kept track of how many squeezes and expansions had taken place to date. This provides definite information of just how often this particular construction and material could go through its operating cycle without failure. After probably two or more years, some new and useful feature will be added to the automobile using this construction with the assurance that it will perform as the designer had hoped, all on the strength of the very thorough and exhaustive tests conducted by the research engineer.

Engines to the Right, Engines to the Left

This laboratory is the house of engines. Room after room contains engines. One department is finding out one particular point about engine operation, and another department is gunning for something else; but all the while the visitor encounters engines and more engines.

The engines being tested are mounted on special stands and directly connected to electric generators. The generators, in turn, are electrically connected with resistance which comprises the load, and with measuring instruments to indicate how much work is being done at any given moment. These generators with their control and indicating instruments are known as electric dynamometers. All engine exhausts are led outdoors, of course, unless they are to be chemically tested.

In some experiments the entire engine is used. In other experiments only a single cylinder of a given type of engine is used, since it is found simpler and more satisfactory to obtain the desired data with a single cylinder. One interesting experiment in progress during the writer's visit was aimed at learning what road dust and grit do to the cylinder walls. A single-cylinder engine was merrily chugging away while overhead was mounted a large hopper filled with typical road dust and grit. A pendulum, swinging back and forth, discharged a definite quantity of this mixture into the engine intake, for each counted stroke. Here again was the yard stick idea at work. In another part of the laboratory the writer noticed how the exhaust gases of an engine are gathered in test tubes for chemical analysis, in order to determine the degree of combustion as an accurate measure of fuel metering and distribution. All kinds of metering devices are available in checking over the performance of the engines on the testing blocks.

One of the many products worked out by this laboratory is the so-called oilless bearing. Through the use of finely powdered copper, tin and other ingredients, pressed into cylindrical pieces under very great pressures, it is possible to produce bearings of remarkable porosity. Indeed, these bearings look just like the usual bronze bearing, yet if a drop of ink is placed on the metal, the ink is soon absorbed in the manner of the usual blotter. After pressing into shape, heat treatment, and undergoing broaching and other machining operations, these bearings are placed in a tank of hot oil so as to drive out all moisture and permeate the interstices with lubricant. Thus the bearings retain a large amount of oil, and can be used for long periods of time without additional oil. These bearings are planned for those parts of the car that tend to be most persistently neglected by the average motor car owner, and while they are not exactly oilless, they will at least function safely for a long stretch without attention of any kind.

Welding Copper to Iron to Make the Air-Cooled Engine

Among the questions aimed at the automobile were those pertaining to the water-cooling feature. Why should the engine be water-cooled, involving, as this does, heavy water jackets for the cylinders, a bulky radiator, a water pump in many instances, and so on? Why not air-cooling?

The answers received were substantially to the effect that water was the simplest way of accomplishing the end in view. If an engine was to be air-cooled, it required a great deal of radiating surface in the form of fins, together with a large volume of air steadily propelled past the radiating surfaces. That is to say, this is the case with iron radiating surfaces; for iron is a relatively poor conductor of heat. Copper, on the other hand, conducts heat some nine times better than iron; or to put it another way, it takes just one-ninth as much copper to obtain the same heat conductivity as with iron.

To the next question: Why not use copper?

Answer: Because you can't make a cylinder of copper, and you can't weld copper to an iron cylinder.

And the question: Why can't you weld copper to iron?

Answer: It has never been done; it can't be done.

It was decided to take a week to study this problem, and then report in detail why copper could not be welded to iron.

The week went by. The engineers were unable to report with such finality as is necessary to balk Mr. Kettering, why copper and iron should not be joined together. There were excuses, of course, but they did not seem sufficient. For one thing, iron and copper readily oxidize when subjected to the heat necessary for brazing or welding operations, and iron oxide and copper oxide will not join hands. But all the excuses notwithstanding, and not to be deterred by the fact that it had never been done before, Mr. Kettering's orders were given to study the problem and solve it.

The result is that this laboratory has evolved a simple and highly efficient type of air-cooled engine, in which the cooling is achieved by means of crinkled ribbon of copper welded upon the usual iron cylinder. The "impossible" has been made possible. The chemists and metallurgists first determined why the task could not be done, and then set to work removing the obstacles one by one.

To test the quality of the work in the finished welding, the laboratory men endeavor to shear apart the iron and copper members with a cold chisel and hammer. If the work has been properly done, the copper will start with the iron or the iron with the copper, as the cold chisel is driven along the line of juncture. That is to say, just as with iron welded on iron, the weld is stronger than the adjoining metal.

That air-cooling, by means of copper fins, is entirely feasible, there can be little doubt. Much remains to be done before the water-cooled engines of today are seriously threatened; but it would seem as though the air-cooled automobile must eventually come into its own. Air cooling makes for lightness, efficiency, simplicity of parts, less repairs and lower cost, not to forget the elimination of winter's worst trouble.

Making Each Pound Work

The air-cooled engine is bound to have a far-reaching effect in automobile design. Air cooling means a lighter engine for the same power. To this add the saving in weight effected by eliminating the radiator, water pump, gear train and so on. Again, add the increased power which can be obtained by higher compressions, as the result of "doped" fuel. Still further, add the accumulated knowledge in especial alloys and better ways of obtaining strength by means of ingenious design. The sum total enables the automobile designer to produce a surprisingly light yet efficient car.

Why operate a car weighing 3000 pounds or more to carry the boy or girl to the near by school? Why go to work in a big car intended for the whole family and for long trips in comfort? Why go shopping in

(Continued on page 62)

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The Pacific Northwest's New Industrial Center

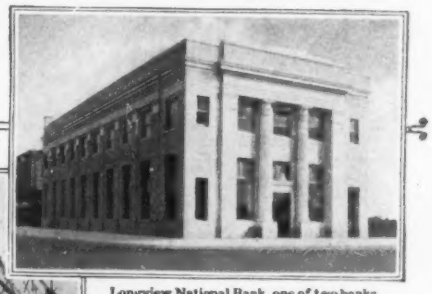
LONGVIEW
Washington

THE CITY PRACTICAL THAT VISION BUILT

Hotel Monticello in Longview—modern, fire-proof, 200 rooms with bath—a mecca for tourists.

Commerce Avenue—a little more than a year ago marked only by surveyor's stakes.

An ocean-going freighter unloading cargo at Longview's temporary docks on the Columbia River.



Longview National Bank, one of two banks in the new city, with combined deposits of 1 million dollars and 2,500 depositors.

A view of The Long-Bell Lumber Company's great manufacturing plants taken February 11, 1924, from a point nearly a mile away, on the opposite bank of the Columbia River. This plant will start operations in July. Thirty-four acres of buildings are under roof. The docks in the foreground are 1400 feet in length.

LESS than a year ago, there was announced the beginning of a new industrial city in the Pacific Northwest—Longview, Washington, halfway between Portland and the Pacific Ocean on the Columbia River. At that time, Longview's chief claims for recognition as a logical site for industries that sought an ideal location in America's fastest growing section were transportation by rail, by river, by sea and by highway; raw materials; fuel and power; accessible markets; and a mild, healthful climate.

Today, Longview has all these and more! Today, Longview is a live, thriving, going, growing city of more than 5,000 population. It has 74 miles of paved, graveled or graded streets; 17 miles of concrete sidewalks; 14 miles of water mains; 22 miles of storm and sanitary sewers; 18 miles electric pole lines; 6 miles underground electrical installation; many permanent business buildings; three modern hotels, one—The Monticello—equal in beauty and service to any in the Pacific Northwest; a modern school, with 850 pupils and 24 teachers; an eight-column, eight to twelve page daily newspaper; nearing completion, Columbia River docks with a berthing length of 1,400 feet, The Long-Bell Lumber Company's gigantic fir lumber manufacturing plant, an electric power plant with an ultimate capacity of 36,000 kilowatts; The Longview, Portland and Northern Railroad, under construction, extending in a northerly direction from Longview through a rich agricultural section and opening up one hundred thousand acres of the finest virgin fir timber in the Pacific Northwest; more than 600 homes built, and many others now under construction; a "Community House", replete with gymnasium, swimming pool, auditorium, etc., the center of civic and athletic activities for both men and women; churches, lodges; a complete municipal government; modern street lighting system; parks, golf course, tennis courts; boulevards; a post office, less than a year old, advanced from fourth to second class; suburban garden lands opened and being settled.

Such is Longview today!

Located in the heart of the Pacific Northwest with its abundant undeveloped resources, in one of the most rapidly growing sections of that great empire, offering transportation facilities that include rail, river, ocean and paved highways; offering a modern, model community, expertly planned in advance; unexcelled climate; offering ideal industrial sites and other land and business property at reasonable prices—Longview presents a layout of remarkable attractiveness:

—to industries, both large and small, seeking a Pacific Northwest location;

—to persons seeking an ideal place in which to live;

—to suburban farmers, truck growers and dairymen.

Longview should be seen for a proper appreciation. It is in the direct line of summer tourist travel in the midst of wonderful scenic grandeur, at a point where the paved Pacific Highway, running north and south, first meets the famed Columbia River Highway. Three transcontinental railroads—the Northern Pacific, the Union Pacific and the Great Northern—are at its door; pleasure steamers ply up and down the Columbia River and the mighty Pacific Ocean is but 50 miles to the west. Include Longview in your trip to the Pacific Northwest. Longview will give you a true western welcome and you will see the marvelous spectacle of a great city being built before your eyes.

The Great Long-Bell Plant Starts In July

IN JULY of this year The Long-Bell Lumber Company will begin the operation of its great fir lumber manufacturing plant now nearing completion in Longview. To see it in operation is well worth including Longview in your trip to the Pacific Northwest. This company owns large tracts of fir timber adjacent to the new city and, after a most careful investigation, selected Longview for its great plant because of its perfect location.

Summer railroad rates of approximately one-half fare for the round trip to Longview and other Pacific Northwest cities now in effect.

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COLGATE & CO. Dept. 40, 199 Fulton St. NEW YORK

Cross-Examining the Automobile

(*Continued from page 60*)

3000-pound car? Why operate such a heavy car for the everyday routine? Again Kettering has asked a question.

Air-cooling and simplified design will make a smaller and lighter car possible. It is not too visionary to predict the day when many families will have a standard automobile for long-distance driving, and a really smaller car for routine transportation, thus effecting a great economy in their automobile budget.

This question of weight is receiving serious consideration. It may be alright for railroads to haul three tons of steel in their Pullman coaches for every passenger carried, but in highway transportation every pound must be put to work. That is why the writer was shown some interesting developments in all kinds of road transportation vehicles that evinced the study given to the ratio of "pay load" to dead weight.

The finish of the automobile body has received its due quota of research. While this phase of the automotive industry might rightfully be laid upon the doorstep of the paint industry, the fact remains that the automobile research men have found it necessary to take up the problems from where the paint manufacturers leave off, just as they have done in the case of special steel, fuels, and so on. Better and less expensive ways of finishing automobile bodies have already been evolved and some of them are in production at this time.

When the Research Man Cuts Down Costs

Were the research man engaged in pure research work, his part in the workaday world would not be of prime importance. However, the research man not only engages in practical problems having to do with the turning out of better products, but he also works out production methods in the laboratory to the point where every step is smoothed off and the rough corners removed. Not only is the new product turned over to the manufacturer, but the entire scheme of production, carefully worked out in detail, is turned over to the production manager. Costly mistakes which might develop in actual production work are avoided by carrying on experimental production, which is production merely on a miniature scale. The errors that are bound to crop up in trying a new thing for the first time may then be corrected easily and inexpensively.

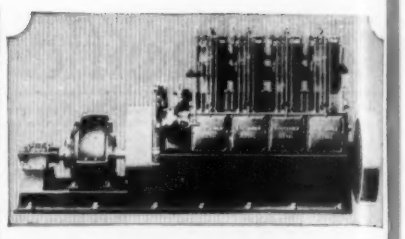
There are many other things being done by the research men of this laboratory—big things and little things, all tending to make the present automobile better and still better, until we have a machine that meets the specifications mentioned at the beginning of this story. That is what Kettering and his lieutenants and his army of researchers have in mind—they have purposely aimed high in order that their work may carry them far ahead. And here's hoping that they reach that mark!

Volcanoes—Or Cosmic Shell-Holes?

(*Continued from page 11*)

Mare Crisium, as examples, are simply the evidences of gigantic impacts releasing molten rock and spreading it radiantly over vast areas. Also it is not difficult for him to realize that all the typical craters, whether on the hard cooled surface of these seas or elsewhere on the moon's surface, are due to additions of solid matter received from the outside, which struck the surface of the moon at the speed which such bodies are known to possess.

It is interesting to study the flat-bottomed craters near the edges of or in the seas which do not show the typical central hill, like the crater Plato, for example, and Aristoteles to the north in Mare Imbrium. They may easily represent later impacts which broke through a thin cooled crust, the impacting mass entering the liquid material beneath, with the result that this molten matter rose to the level of the surrounding plain; or they may have been pre-existing craters which were partly but not wholly filled by the molten material which formed the seas. Some of the largest craters on the moon do not show the central hill, apparently having a more or less smooth floor. This may indicate that the impact was of sufficient violence to make liquid the more deeply seated material which subsequently cooled and formed the floor of the crater, or, as suggested, that the impacting mass broke through a crust into liquid material beneath. It is particularly interesting to note the differences between the various craters on the moon's surface, and it is not difficult, as I shall try to show later, to pick out the older



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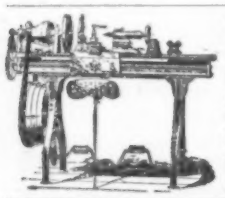

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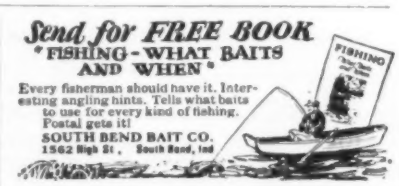

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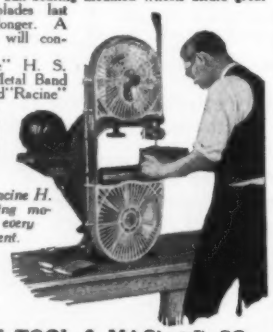

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impacts, then those younger, and finally the still more recent and last impacts. There is no doubt, in my opinion, that most of the craters were made when the surface had cooled off sufficiently for the impacts to produce effects *very* similar to those produced at the Meteor Crater in northern central Arizona, in fact so closely resembling these effects that, in my opinion, we must conclude that they had a similar origin.

Let us examine into these features which are so similar. The relation of depth to width is much the same. There is the same uplifted rim made higher by the material ejected from the crater. The exterior and interior slopes from the crest of the rim to the surrounding exterior and interior surfaces are much alike and moreover the rims are more or less similar around their entire circumferences. They both have the typical central hill. Both they and the Arizona crater bear evidence of having been made and completed in an instant of time immediately after and before which all was quiet in that particular locality. In this respect they differ greatly from terrestrial volcanic craters which commonly show that many and great changes in form have occurred during their long periods of volcanic activity. Small lunar craters are often seen inside of larger craters, but these, I believe, represent in every case later impacts. It is very interesting to note that many of these small secondary craters have the same nipple-like central hill, clearly showing that they had the same origin as the larger craters in which they are located. In the same way larger craters in innumerable instances have undoubtedly obliterated smaller ones. The important point of resemblance that the floor of the craters is far below the surrounding original surface, which is characteristic of impact craters but is not characteristic of volcanic craters, is significant of an origin similar to that of the Arizona crater. Finally the force of the impact was not sufficient to produce general fusion, or the condition of the target was not favorable thereto, as suggested above, and we see the same or very much the same characteristic splash-like distribution of the ejectamenta including a vast amount of finely pulverized rock or rock flour, which as hereafter will be seen would probably be quite white in color. This cannot be too strongly emphasized. When one considers the above facts in an unprejudiced way, in connection with the fact that most of the lunar craters are startlingly alike, one is, in my opinion, forced to conclude that they, like the Meteor Crater of Arizona, bear the evidences of impact and the evidences of nothing else. (*The above is the first half, approximately, of Mr. Barringer's paper. The balance will appear in an early issue.* —THE EDITOR.)

With the "Limited"

(*Continued from page 14*)

at junction points. And then again, a long distance train is a combination of both speed and distance. Some, truly, travel for one, two or even three thousand miles, but at a slow speed, performing rather a local than an express service. The average speed of the thirty-seven 2000-or-more-mile trains detailed above, it will be seen, is only 29.2 miles per hour. The fastest-farthest-traveled train on this continent, retaining at least 50 per cent of its identity for its whole journey, is the Trans-Canada Limited, of the Canadian Pacific, which travels 2885 miles at an average speed, including stops and three meridianal changes of time, of 32.1 miles per hour. The Continental Limited of the Canadian National travels farther—2937 miles, to be exact—but at slightly less than 27 miles per hour. Two other famous trains, the Columbian of the Milwaukee (2208 miles) and the Missionary of the Santa Fe (2244 miles) average less than 30 miles an hour.

The nomenclature of these star trains is quite interesting. Some of their names reveal a gift of authorship. When you come to think of it, it is considerably harder to find a name for a train than for even a baby. There are some names, of course, which are obvious, such as the Buffalonian, Canadian, Californian, or Shasta. Others suggest local slang, such as the Badger State Express, Buckeye Limited, Hoosier, Panhandle Express, Copper Country Limited, Gopher State Express, Flying Bluenose, Crescent City Special, Gopher State Express, and so on.

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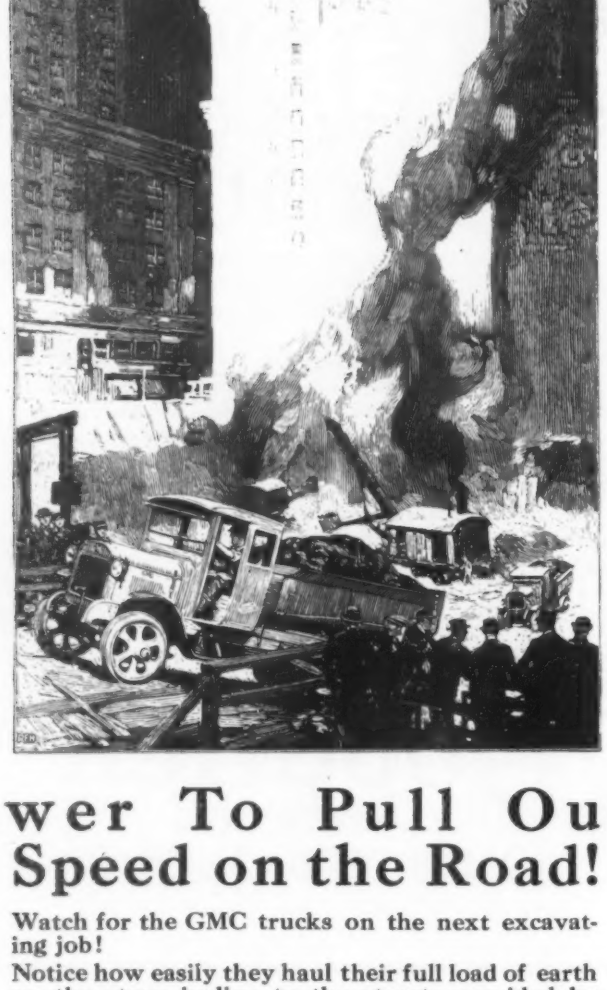

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Our Abrams Investigation—X

(*Continued from page 16*)

with variations in any other known factor. They were independent of anything which was supposed to bring them in or send them out. Whenever these variations did not behave as they should, which was the case most of the time, we were informed by the doctor that there was a "lag" in the reactions. This "lag" persisted for periods of 15 minutes. The doctor failed to observe that the most pronounced "reaction" obtained in the course of the sitting was due to a crease in the reagent's skin made by the tight draw string of the bloomers during a rest interval.

On May 7 there were two sessions, one in the morning and the other in the afternoon. The morning session followed much the same lines as that of the previous day, with the same girl reagent and with Mr. Bird acting as the student to whom the reactions were to be shown. Three vials containing certain drugs alleged to elicit definite reactions, were placed on the dynamizer at various times. The doctor himself obtained the desired reactions at times, and none at other times. Bird failed to detect the reactions felt by the doctor, as he passed the glass rod over the abdomen of the reagent immediately after the doctor had made the rod "stick" in a certain area. There was a most pronounced "lag" in the coming and going of the reactions, so that the reagent had to "rest" for considerable periods.

The afternoon session was conducted with Mr. Ingalls of our staff acting as the reagent, and Mr. Lescarboura as the student. The same procedure was followed as in the morning session, with substantially the same negative results.

On May 8 we held the fourth session, with Mr. Ingalls as the reagent part of the time, and Mr. Lescarboura for the balance, these two men alternating as reagents and students. Mr. F. B. Fishburne of Columbia, S. C., an ardent champion of E. R. A., attended this session. Both Ingalls and Lescarboura obtained variations in the "drag" of the glass rod over the skin of the abdomen, but these variations were not in the areas indicated by the doctor and, furthermore, they did not seem to have any connection with the "reactions" sought. Lescarboura during this session observed that the doctor held the glass rod in two distinct ways. When the reactions were obtained, the glass rod was generally slightly tilted with relation to the surface of the abdomen, and only the end of the rod was in contact with the skin. When no reactions were obtained and the rod slipped over the skin without apparent drag, the glass rod was generally held quite flat against the skin and did not take hold, so to speak. These observations are offered for what they may be worth.

To indicate that these reactions had no diagnostic significance at all, one of the two persons just mentioned discovered at home on the evening following the tests, that the same "drag" was felt in the same place by means of a common round lead pencil and that it occurred definitely at a small loose fold of flesh.

On May 15 we held the last session with this doctor, in the presence of the major part of our investigating committee. Mr. Roy Williams of our staff served as the reagent, and the doctor again endeavored to demonstrate the reactions. Again there was the exasperating "lag," which is rarely encountered in regular diagnostic work, at least as far as our observations go. With Williams, as with the other reagents serving in this series of tests, the doctor endeavored to have him feel some sub-cutaneous impression brought about by the reactions. Pressing his finger at a certain spot on the ab-

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domen, and looking at the reagent with a despairing look, the doctor asked if any special sensation was felt. He then insisted that he felt something like a lentil or a tiny pimple under the skin. The members of the committee time and again searched for this "lentil" spot and failed to find anything out of the ordinary. It was a poor substitute in the absence of a satisfactory glass rod demonstration of the Abrams reactions.

Because of the "lag" and the generally unsatisfactory performance of the reactions, the doctor voluntarily gave up the demonstration. Then followed a lengthy discourse regarding the E. R. A. technique and the difficulties of proving its numerous claims before a group of scientific minds. The high spots of the discussion can be summarized in the following questions asked of the doctor, and the answers received:

"Now, doctor, if these reactions really take place—take place objectively, rather than subjectively or in your own mind—you can prove it to us in 15 minutes."

The Doctor: "Hardly. It took me a year of solid experimentation and study before I convinced myself of the existence of the reactions."

Our Committee: "It surely can be proved in short order. Supposing you get a definite reaction with a given specimen. Then let us place a screen between you and the dynamizer. The reactions should indicate when the specimen is in the dynamizer and when it is not."

The Doctor: "I have tried that test. It won't work. The lag in the reactions would interfere with the accuracy of the results."

Our Committee: "Well, you claim you get reactions from blood. Then, supposing we take ten pieces of blotting paper, all identical, and place the identical blood on, say, two of them, and leave the others blank. The blotters are then placed in envelopes or wrapped in tissue paper. Surely you should be able to pick out the plain blotters from those with blood."

The Doctor: "I have tried that same test. I get about 50 to 60 per cent correct results."

Our Committee: "Fifty per cent is hardly more than chance. Sixty per cent is hardly impressive. You should be able to do much better than that to convince the scientific world that these reactions really take place, and that they stand for something."

The Doctor: "This E. R. A. technique works miracles at times and then fails completely at others. At present I cannot do the experiments which you propose with any certainty of success."

Our Committee: "Well, isn't there some simple thing which you could do so that we might know that these reactions are objective phenomena rather than products of your own mind? How about breaking the connections in the circuit? Wouldn't that indicate that the reaction-producing energy really flows through the circuit?"

The Doctor: "Breaking the wires or interrupting the circuit proves nothing. I have had the electronic energy pass through several feet of air gap without appreciable difference. That is something which we electronists learned early in our work."

Our Committee: "But supposing we ran the circuit into another room, and broke the circuit by ten feet or more, could you detect such a break?"

The Doctor: "No. It probably would make no difference."

Our Committee: "Well, can you tell us of anything you could do which would demonstrate in a scientific manner the existence of these reactions and give some basis for your everyday E. R. A. practice?"

The Doctor: "I am afraid there is nothing I can do. I know the reactions are there, but there is no way I know of to show them to you. You gentlemen, with your scientific knowledge and facilities, should help us develop ways and means of demonstrating these reactions so that anybody can detect them."

Our Committee: "We feel that such is really your job, rather than ours. The burden of proof in this case rests with you and the E. R. A. men, just as in the beginning. Unless you can do something more convincing than you have already done, you will never prove your case before the thinking world."

Unabashed, the doctor then went on to discuss at length the serious interference of radio waves. It seems, so he told us, that in the beginning, say back in 1920, the E. R. A. diagnostic technique was more positive. The early results of Abrams were exceedingly accurate and startling, so we are assured,

(*Continued on page 69*)

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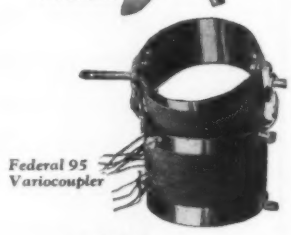
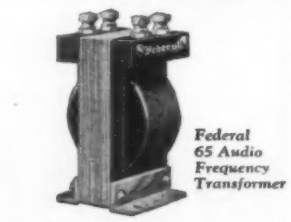

Federal 95 Variocoupler


Federal 65 Audio Frequency Transformer

Federal
Standard RADIO Products

Radio Notes

The Armstrong-DeForest Controversy as to the origin of the "feed-back" and regenerative circuits has again been settled by the court of law. This time the decision was handed down at Washington by the U. S. Court of Appeals, declaring Dr. Lee DeForest to be the originator and sole inventor of the "feed-back" and regenerative circuits heretofore accredited to Major Edwin H. Armstrong. It is still too soon to decide just what will be the effects of this startling decision. As this is being written the Radio Corporation of America reports that its legal department is not yet ready to issue a statement or make any predictions.

New Radio Clip.—A novel clip designed to give high electrical conductivity is the invention of Eugene Pons of Schenectady, N. Y. It is a double-grip clip for use in radio or battery work, and has two continuous electrical paths unbroken by hinge joints or pivot pins. The current therefore does not pass through and take the temper from the spring. An absolutely tight connection is possible in five seconds with the Pons clip, it being only necessary to press one end, attach, and press the opposite end. In other words, the Pons clip is a double-headed proposition, with gripping teeth at both ends. This makes it applicable in many different ways.

A Voltmeter for Battery Testing is practically a necessity if best results are to be obtained as a regular performance. A small voltmeter with a scale of 1 to 50 volts should be on hand at all times to check up on the condition of the "B" and "C" batteries. After all, the only way in which the condition of these batteries can be ascertained is by the voltage reading. Often the trouble with a set is attributed to the "B" battery, when in reality the battery is quite up to the mark. For the best practice, the voltmeter should preferably be of the two-range kind, with one scale reading from 1 to 50 volts, and the other from 1 to 5 volts for testing out the "C" battery accurately. The storage battery can be tested with the hydrometer in the usual way.

Heroic Radio Operators.—The United States Shipping Board has called the Bureau of Navigation's attention to the unusual services performed by radio operators Howard A. Moyer, Charles R. Stewart, and Alexander D. MacAlpin, aboard the "President Monroe" when the vessel encountered heavy weather in the North Atlantic during January. These operators jeopardized their lives in assisting in erecting the ship's antenna, which had washed overboard, notwithstanding the fact that the officers of the ship refused to allow the members of the deck force to assist the operators in this hazardous work. Their faithfulness to their duty, however, inspired them to erect the needed antenna and thereby maintain the radio installation in operating condition for an emergency.

The DeForest Vacuum Tubes now available for reception purposes come in two types, one intended for operation on dry cells, and the other for operation on storage battery. The former type has a horizontal mounting for the elements, and resembles the DeForest tubes of a year ago. The latter type, on the other hand, has the elements mounted vertically. The DeForest tubes appear to be highly efficient, making use of the so-called activated filament material as compared with the common tungsten and the oxide-coated filaments. Furthermore, the DeForest tubes are practically free from microphonic noises. This last feature is most desirable, since all receivers are not provided with cushioned sockets, and the microphonic noises are often quite annoying when using other tubes.

Static Phenomenon.—At this time of the year when static interference becomes the rule rather than the exception there is ample opportunity of becoming familiar with this phenomenon. To the careful observer it must be apparent that static interference increases with the reaching out for distant stations, as a general rule. However, static interference also seems to differ with the direction of the incoming signal. Still further observation will disclose the fact that static is by no means limited to local conditions. Thus a weak transmitter in the immediate locality may be intercepted without static, while a more powerful transmitter at some distance away will be intercepted with considerable static disturbance, although the intercepted signal strength may be the same for both transmitters. It is held by some radio authorities that the radio waves carry the static disturbances along with them.

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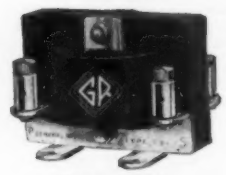

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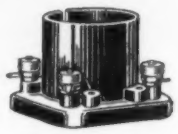

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BURGESS
RADIO BATTERIES

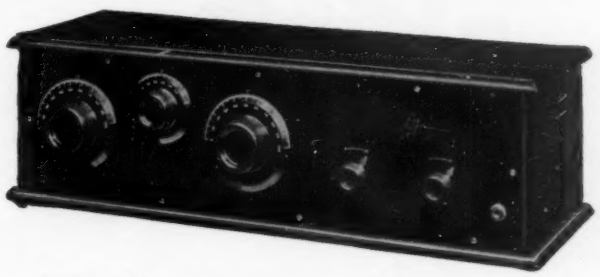
Whatever the cause may be, it is a fact that static hangs on to some waves better than it does on others.

Dry Batteries for Radio Use.—Among the standard assemblies of dry cells adopted by the conference held at the Bureau of Standards, 1921, there were included two batteries for radio use. Since that date the demand for dry batteries for radio purposes has increased very greatly and the conditions of use have been considerbly changed. It appears desirable, consequently, to revise the specifications for the performance of such batteries. In anticipation of another conference to consider this problem the Bureau and a number of battery manufacturers have been carrying out extensive tests in order to determine the type of performance tests to be established and proper numerical values for these requirements. The matter has also been taken up by a committee of the American Electrochemical Society on which the Bureau is represented. It is planned to call a conference of dry cell manufacturers and others interested to meet at the Bureau within the next few months.

WBZ—The Super-Station of New England.—From a rather weak and certainly local station, WBZ of Springfield, Mass., has developed into one of the super-stations of far-flung range. The transmitter has been replaced by a more powerful transmitter, so that the station is now heard far and wide. But the most amazing feature of this station is that it is a remote-control affair. The studio for WBZ is located in Boston, 100 miles distant, a special Western Union telegraph line connecting the studio on top of the Brunswick Hotel with the transmitter. The studio represents an ambitious undertaking, being in the form of a distinct building on the roof of the hotel. This building has been constructed in such a manner as to exclude all sounds of a busy city. The sound-proofing was accomplished by constructing the building out of hollow gypsum blocks and covering the inner surface with a cellulose material that would reflect any sound that might penetrate the outer wall. The interior of the studio has been draped with special flannel material and carefully carpeted to kill troublesome sound reflection.

To Obtain Louder Signals, there are five fundamental methods used: (1) The well-known principle of regeneration; (2) super-regeneration; (3) radio frequency amplification; (4) audio frequency amplification; (5) super-heterodyne. According to one radio authority, the limitations of each scheme are as follows: (1) The regenerative circuits, when pushed to the limit of signal strength, are permitted to oscillate and act as small transmitters, thus creating interference for nearby receiving sets. (2) Super-regeneration, which is a development of the regenerative idea, is not selective and, what is of prime importance, it is difficult to control. (3) Untuned radio frequency amplification by means of transformer coupling does not do justice to all wave lengths, while tuned radio frequency amplification requires too many adjustments to tune the various circuits. (4) Audio frequency amplification is limited to two stages. (5) The super-heterodyne is free from the limitations possessed by other methods of amplification, but is complex in construction. The super-heterodyne is sensitive to weak impulses. It is a sharp tuner, but not critical. It is easy to operate, as it has only two controls.

The Radiating Receiver continues to occupy the limelight of the radio stage. Everyone seems pretty well agreed that the radiating receiver, particularly in the hands of those who make it radiate, is a veritable pest which must be exterminated in short order. But when it comes to the *modus operandi* of the extermination process, there is a conspicuous absence of concerted action. The lazy way out is in the suggestion that a law be passed prohibiting the use of radiating receivers. More laws! The idea is howled down as soon as it is put forth. First of all, we do not want meddlesome laws to be added to our radio troubles; and in the second, such a law could hardly be enforced except with a stupendous force of radio inspectors. There are hundreds of thousands of "squealing" radio receivers now in use—some bought as recently as six months ago, with the assurance that they were the last word—and they are not going to be junked over night. So the solution must be found in the way of making over existing "squealers." Here the problem is to find some relatively inexpensive method of taking the "squeal" out of the "squealer" without cutting down its efficiency. Some of the simpler ways of doing away with the



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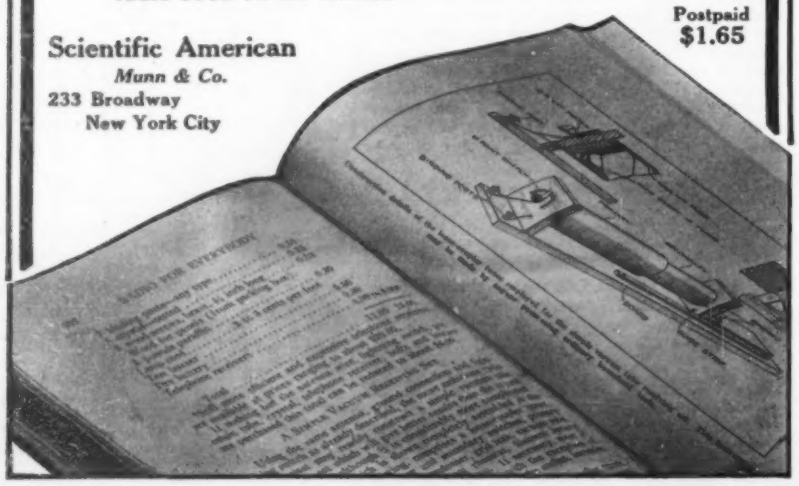

radiation also do away with a good deal of the signal strength, hence do not appeal to most of us. Fortunately, radio manufacturers are now coming to our rescue with suitable radio-frequency units which may be added between the tuning unit and the detector of the usual set, and, in at least one case, directly to the antenna circuit, with an output coil which is placed in close proximity to the inductance of the receiving set.

The World's Most Super Super-Heterodyne.—Radio has apparently entered a new era in which the aim is to use more and more tubes, with the accompanying elaboration of the receiving apparatus. Thus from the three-tube regenerative sets of two years ago we have gone to the five-tube neutrodyne and other radio-frequency amplifier types of receivers, and on to the five to eight-tube super-heterodyne receivers. And the end is not yet in sight. Ambitious experimenters here and there are reaching up to ten tubes and over. Now comes R. F. Green of New York City, with his giant super-heterodyne receiver that operates on eight, nine, eleven, or fourteen tubes, arranged as follows: Eight tubes in the super-heterodyne, two tubes in the audio-frequency amplifier, and the remainder for radio-frequency amplification ahead of the super-heterodyne proper. This set has 275 volts of B-battery, and operates on a single A-battery of six volts, 150 ampere-hour rating, with another A-battery of 100-ampere-hour rating in reserve. The cabinet is 41 inches high, 3 feet 6 inches long, and 16 inches deep. The panel carries in all 19 dials, as well as two meters. This set requires no ground and no antenna.

The Neutrodyne Receiver is not going to be disposed of in the near future, so far as receiving circuits are concerned. With the exception of the super-heterodyne, which is a more elaborate and therefore more costly circuit, although simpler to operate than the neutrodyne, the latter has all the desirable characteristics sought by the average broadcast listener. The neutrodyne is quite simple to operate; indeed, once the various stations are "logged"—that is to say, the positions of the three dials recorded for given stations—anyone can bring in any desired station on the air by setting the dials to the predetermined positions. The neutrodyne is highly selective. It is remarkably efficient, bringing in long-distance stations. The three jacks of the usual neutrodyne receiver make it possible to plug in head-phones directly after the detector, with two stations of radio-frequency amplification; and this combination proves ideal for real DX work, with a minimum of parasitic disturbances. Normally, the set is operated with the full five tubes, for loud-speaker results. The neutrodyne is free from squeals and squawks. The loud-speaker or head-phones remain silent until the three dials are tuned in. All in all, the neutrodyne is here to stay for a long while to come.

The Grid Leak is of far greater importance in receiving efficiency than is generally realized. The volume obtained from any receiver depends on the grid current and directly on the plate current. An important factor which determines the grid current is the number of negative electrons which are attracted to the grid from the filament. The negative charges on the grid sometimes reach a point where they practically stop the flow of plate current. The grid current piles them up. Unless a good grid leak is in use the tube will become choked up and will not operate. If the grid leak is of the incorrect size, the tube will only partially operate. According to Ernest W. Sawyer, a radio engineer, each type of vacuum tube creates new conditions. The UV-199 provides a high emission at low filament temperatures. The UV-201-A averages five times the emission of the ordinary amplifying tube. The emission or flow of electrons varies with the current and voltage being used. In other words, every time the "A" or "B" voltage is varied, the grid leak should be varied. It appears that for maximum efficiency the grid leak resistance should be as follows: For WD-11 and WD-12, 2 to 3 megohms. UV-200, ½ to 2 megohms. UV-201-A, 2 to 9 megohms. UV-199, 2 to 9 megohms. A grid leak resistance between 2 and 5 megohms is satisfactory for average work. A resistance between 5 and 9 megohms is somewhat better for weak signals. At first thought it would seem advisable to provide all sets with a variable grid leak, but the public generally prefers to have less adjustments; hence the next best thing is to adopt for each type of set that fixed grid leak which gives best average results on local stations.

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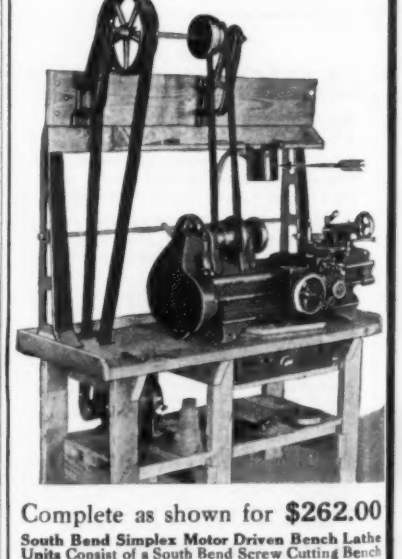

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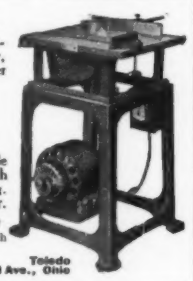

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Our Abrams Investigation—X

(Continued from page 65)

whereas present-day work—under test, of course—is subject to error. The rapid increase in the number of radio broadcasting stations is causing the most troublesome interference so far as the illiciting of accurate reactions is concerned. For some reason the waves lengths within the present broadcasting band are the most troublesome as regards the electronic reactions. We suggested that ship stations were using wave lengths within the present broadcasting band several years ago, but the doctor did not seem to take this fact seriously.

In truth, this radio interference problem has been steadily growing in importance. About a year or so ago the electronists first discovered that radio broadcasting waves were positively interfering with the reactions. Since then they have been studying this menace and have evolved a "cage" or enclosure of copper screening, properly grounded, to shield the electronic apparatus and the reagent from the interfering waves. A "cage" of this kind has long been used in radio experimentation and by the Bureau of Standards in certain delicate work, but it is a recent addition to E. R. A. technique. We are told that there are some fifty "cages" in use today as proof of the desire of E. R. A. men to overcome all chances of inaccuracy in their work. Our doctor went even one step further, and insisted that we, the Scientific American Committee, be credited with this latest technique, since we had pointed out to E. R. A. men the uncertainties of their previous diagnostic findings.

It does begin to look as though the electronists prefer to have us judge their technique by its treatment rather than its diagnostic side. A communication to this committee, dated May 5th, and signed by the committee of electronic investigations, reads as follows:

"As electronic practitioners, we stand ready to defend our position whenever challenged by earnest and fair minded investigators who are looking for the truth.

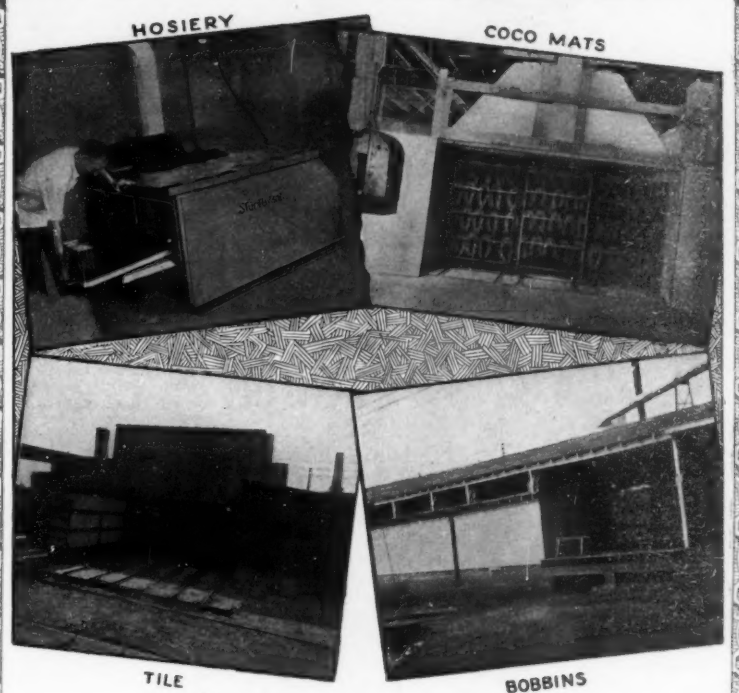
"We therefore appreciate your offer to publish all E. R. A. claims that can be satisfactorily proven. The following has therefore been agreed upon by a committee of physicians representing the different State and sectional electronic associations:

"We would like to emphasize the fact that as a committee, we do not sanction all claims made by individual electronic practitioners, nor the findings obtained by unstandarized technique. We cannot do this any more than any other association can sanction the actions of individual members. Especially do we decry some of the claims set forth in propaganda literature. We feel, however, that many of our claims have been misunderstood only because of the terms employed. In every virgin field new terms have to be coined or old ones have to be used in a new sense. This frequently leads to misinterpretation. Every effort is being made to standardize our terminology, technique, etc.

"The impression gathered by hundreds of electronic practitioners from daily contact with their patients is that whereas the public is interested in a laboratory test of E. R. A., it is far more interested in a clinical demonstration of actual results obtained. Preparations are therefore under way to furnish the SCIENTIFIC AMERICAN and other interested associations with the following opportunity to personally observe the practical value of electronic diagnoses and treatment as compared with other methods:

"At some convenient location let there be selected a large number of patients suffering from a variety of chronic diseases that are claimed to be amenable to this method. Let these patients be divided into two similar groups and let one-half be diagnosed and treated by electronic practitioners and the other half by the orthodox physicians and let an impartial committee decide upon the results. It is the opinion of our Committee that the most practical procedure would be to attach two or three competent electronists to the staff of a public hospital and for a given time to assign to them for diagnoses and treatment every second patient applying for treatment—with the exception of accident cases, obstetrical cases, and the like. The hospital records of both groups of patients would be evidence of the comparative results obtained by the two methods.

"We would also like to direct attention to the fact that in our daily practice we use not only electronic diagnoses and treatment but also any other diagnostic and therapeutic measures that we consider necessary.



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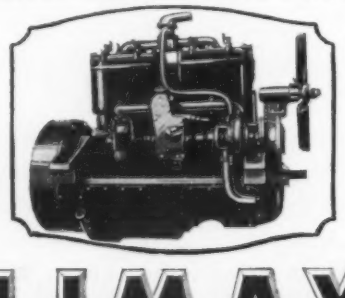

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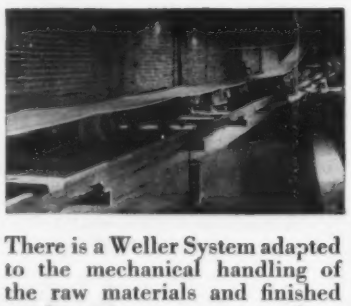

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This matter is receiving the consideration of the Committee and will be reported upon in our next issue. Several months ago it was already obvious that the electronists would be unable to demonstrate satisfactorily the scientific basis for their diagnostic findings and would endeavor to have us judge their work by the treatment side, which lends itself still less to serious investigation than what we have already dealt with.

King Tut-Ankh-Amen's Treasure

(*Continued from page 24*)

object arrived its registration number was noted in an entry book, and in the same book a record was kept of the successive stages of its treatment. Each of the primary objects had been given its own registration number in the tomb, but as these were worked over in the laboratory an elaborate system of sub-numbering became necessary. A box, for instance, might contain fifty objects, any one of which must be clearly identifiable at all times, and these we distinguished by letters of the alphabet or, where necessary, by a combination of letters. Constant care was necessary to keep these smaller objects from being separated from their identification tickets, especially in cases where protracted treatment was required. Not infrequently it happened that the component parts of a single object, scattered in the tomb, were entered under two or more numbers, and in this case cross-references in the notes were necessary. Note-cards, as completed, were filed away in cabinets, and in these filing cabinets we had, by the end of the season, a complete history of every object from the tomb, including:

"(1) Measurements, scale drawings, and archaeological notes. (2) Notes on the inscriptions by Dr. Alan Gardiner. (3) Notes by Mr. Lucas on the preservative treatment employed. (4) A photograph, showing the position of the object in the tomb. (5) A scale photograph, or series of photographs, of the object itself. (6) In the case of boxes, a series of views, showing the different stages in the clearing."

A description of the detailed treatment of many objects follows, but this is of much greater interest when read in connection with views of the objects. Then comes the question of transport after the delicate packing was completed. A Décauville railway was used—it would be more proper to call it an itinerant railway, for the rails were taken up behind the cars and laid down in front, fifty laborers doing this work and pushing the cars; and after 15 hours of actual work to cover the 5½ miles, the precious cases were loaded on the steam barge which arrived safely in Cairo a week later. Thus the antiquities arrived at what will probably be their journey's end, for it does not look now as if there would be a division of the finds as originally called for in Lord Carnarvon's contract.

Our Next Psychic

(*Continued from page 29*)

form, but she must have a fund of definite information upon which to base S. T.'s behavior. F. H. made a case for this improbability which in some respects I could indorse. We ought perhaps to reserve the possibility that the material had come telepathically; with this reservation, if we express doubt that Margery knew enough to support Friday's performance, we have probably gone as far as we should ever go with such a sweeping negative pronouncement. But the topic was so thoroughly hashed over following this performance that she must have been prepared for Saturday and Sunday. Did the performance of these days go beyond that of Friday?

Trance possession, in my judgment, did not do so. There was more physical convulsion, but anybody knows that an evil possession ought to throw fits. I found no evidence of new knowledge as of Sunday. But Saturday's performance was highly artistic and would support the claim that new knowledge was applied. Genuine possession or genuine duality, however, ought also to advance with practice. We must remember, too, that on Saturday the medium was not in trance; and I think we should strongly entertain the possibility that there was here subconscious manipulation of the table by the sitters, as with Ouija.

In early April I sat twice. There was considerable trepidation the first night, and I think some doubt about the expediency of my presence. We were prepared to break up instantly on the first hint of trouble. But Chester came at once, and stayed; and we had an immense display of physical phenomena, with an equally good show the next night. It seemed that the specter of S. T. had been laid. But after my return to New York Chester rattled his bones again, indicating that two of his own aides had kept S. T. in subjection throughout my stay, and that the problem still lacked a final solution.

On any theory of invention, this would mean that S. T. was being held in reserve against the event that I and my committee become too searching. His future history, and the circumstances under which he comes again if he does so, will be awaited with interest. There was not even a threat of his appearance during my late April visit of five days; nor again during sixteen days in May when I was living in the house and sitting every evening with one or more members of my committee, and few or none of Margery's usual group of friends. For the present one would at first blush estimate the moral probabilities of his genuineness (to the extent of being at least a valid duality) as obviously less than those governing the mediumship as a whole, because of the very clean-cut motive for S. T.; but this would overlook the fact that S. T. cannot be a fraud without carrying the whole mediumship down with him. The grounds for judging him intrinsically are inadequate. But I will confess that of all the controls of any description that I have met, in all my mediumistic contacts, the possibility of a real possession from without, as distinct from mere subjective duality, impressed me as being strongest here.

Shortly after my November visit, Margery and F. H. spent a month on the ocean and in Europe. They attended three sittings with the British photographic mediums; and where these average about one "extra" on seven plates with the generality of their sitters, every plate exposed in Margery's presence showed either a psychic portrait or heavy "ectoplasm." This was taken as strong verification of her true psychic character. She also gave five successful sittings herself, in the presence of various distinguished spiritualists and researchers. This makes it necessary to assume that if there is confederacy, F. H. is an accomplice if not the sole one. On this point nobody insists more emphatically than F. H. himself. If his identity ever is revealed, it will become quite obvious that his professional standing is such as to make it wildly improbable that he is other than wholly honest in the matter. Most certainly he would lose far more by public or private exposure in fraud than he could hope to gain by its successful prosecution.

On returning home Margery picked up her seance routine right where she had left it. Old phenomena have been strengthened in the ensuing six months, and new ones developed. The procedure of wandering all over the house with the medium and the manifestations has been dropped; everything now occurs in the seance room. Margery's tendency to fall into trance in full darkness has been eradicated; so most of the sittings are now held without any light, and all of them with the psychic fully conscious and in no apparent condition of abnormality.

Chester's personality, as revealed by the play between him and his sitters, deserves comment. Usually he is very reasonable, putting up patiently with interference and disobedience. He displays keen interest in the scientific side of the case, and in the mechanism of his own manifestations. He finds our language lacking in the words and even the ideas that are necessary to describe his apparatus and his procedure; nevertheless he often attempts such description, using metaphor and analogy of such delightful ingenuity as to tempt one to the feeling that it must be genuine. Occasionally, however, he relapses into a truculent frame of mind, in which he takes offence at every trifle and abuses his audience promiscuously. He has the same keen humor that is noted in Margery, displaying this in his general attitude as well as in numerous specific puns and jingles on the names and doings of his sitters. He displays many characteristics identical with those of his sister, but most of these are stated by her to be a continuation of his life-time traits.

Chester has quite a crew of disembodied assistants, mostly close relatives of the other members of the original seven sitters. It is not at all unusual for some of these to be heard from briefly, by voice or otherwise,

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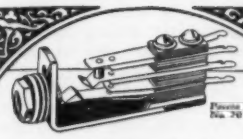

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Chester identifying them when they fail to do so themselves.

Of the phenomena developed since last fall, the most important are the psychic lights. These take wide variety of shape and size, and good range of movement. They are usually visible only to part of the circle at a time, as though dark on one side; Chester gets much amusement from asking who can see them and who can't, and, when this report has been rendered, manipulating them so as to contradict it. But lights are often simultaneously visible to all. I believe they are confined to the region within the cabinet and the circle, and to the sector in front of the medium; within these limits, however, they enjoy all possible freedom. I have seen them when Margery's hands and feet have been completely controlled from the start.

Another item of recent development is manipulation of the curtain pole, both ends of which carry luminous paint, so that its exact station is always observable. Everything that *could* be done with this, without taking it outside the cabinet-circle region, has been reported. The best performance I have seen included balancing it on the megaphone, and terminated with a rotation like that which the bandmaster gives his baton, only much slower .

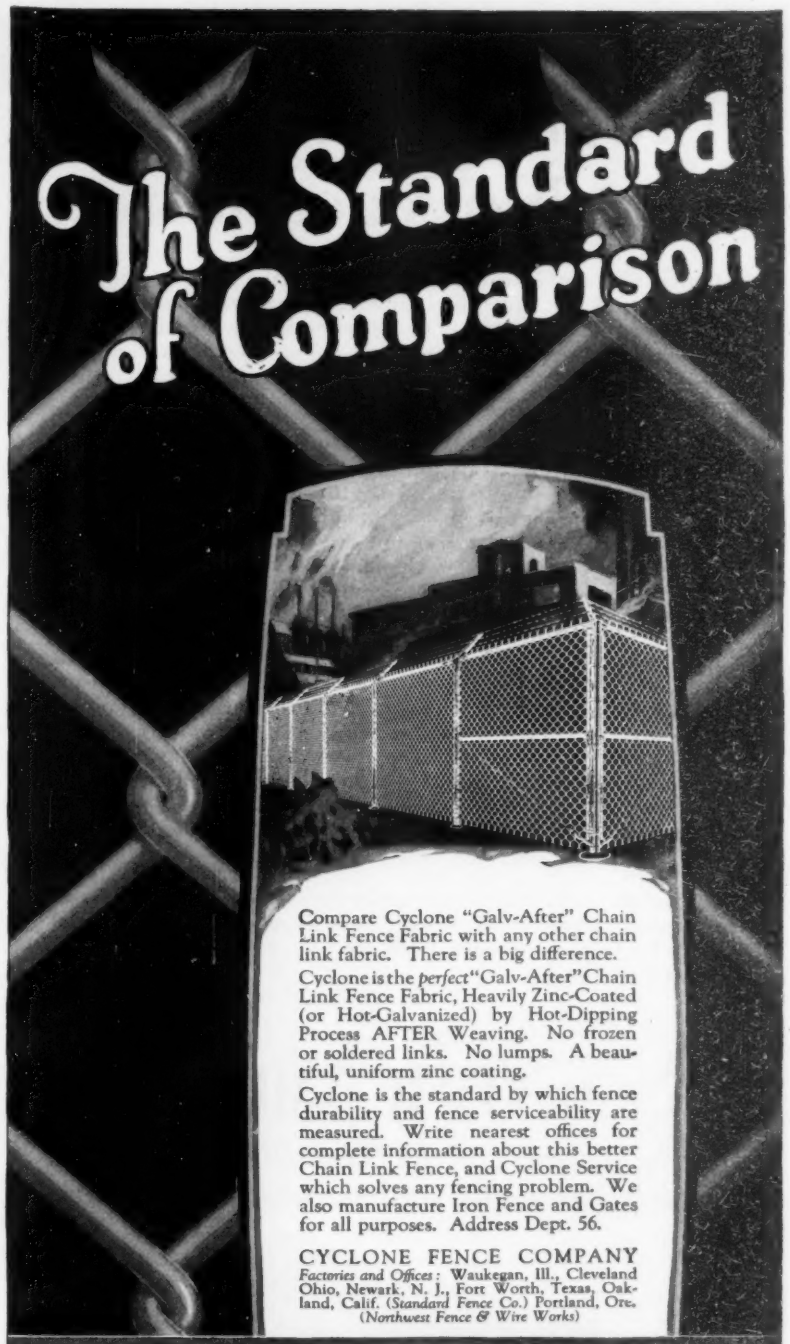
The pole is always in place, across the front of the cabinet and high out of reach, at the beginning. An effort is made to render its initial displacement evidential; it must first be lifted upward to free it from its seat. In my presence, however, this has always been evaded by spreading the cabinet until the pole is released. It does not then fall freely, however, but as though it were under control from the start; and its path is often difficult to explain without assuming the penetration of matter, by the pole itself or by its guide.

Disturbance of the cabinet sometimes proceeds to a point that constitutes an episode in itself. Thus, sitting informally some time ago, a member of our committee was in the cabinet with Margery—a frequent means of control. The entire structure was torn to pieces with extreme violence and brought down about his ears. But nobody was hurt, and the displaced screws were found neatly piled together on the floor!

Another recent innovation is psychic contact. Of course, manipulation of the pole and other objects leads to much contact by them, and this displays the same accuracy in the dark which I have noted with other mediums. Contact as an independent manifestation, however, refers to touches from something of alleged super-physical character. Chester and his friends call it ectoplasm; the sensation which it gives is variant, and apparently under Chester's command. At one time or another it has been described as like soft pinches, caressing fingers, a foot shod in felt, holding of the sitter's ankles, tugging at his trousers, stroking of his head, an animal's paw, a rubber ball, a hard fist, a soft one, a scratching directed at a spot named by the sitter, fur on his lips, a kick in his face, pulling of his hair, a feather, a feather duster, a pair of cool gloves, soft wool, a powder puff, something soft and wet, a soft eraser, a pecking in the face, a blow with a wooden knob, kissing lips, leather fingers—and so on, with no particular end. The regulars see a close connection between all this and the occasional presentation of luminous objects which are announced as Chester's eye, his hand, etc., and which are sufficiently of the appropriate shape to pass uncritical muster. Once a semi-transparent luminous finger was seen with the bones, anatomically correct, visible within it.

Very recently, at Chester's request, a small megaphone has been added to the equipment; and he not only uses this for contacts and such purposes, but within the past few weeks he has begun to talk with it, thus adding trumpet voice to his repertoire. F. H. still jumps out of his skin when the trumpet barks in his ear, and fears he will always do so. For miscellaneous manipulation Chester's favorite objects are flowers, of which there is usually a supply at the beginning. He scatters them about, caresses with them, presents them to the ladies. On at least one occasion, floral contacts were produced in the absence of any material flowers. Another time, with only red roses present, Chester announced yellow roses for certain of the sitters, and made good. Still again, when the rose with which it was assumed that contacts had been made was found at the end in exactly its original location, Chester explained this by saying "I didn't use your rose."

Chester's first apport, however, is his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classic one. He had been promising a live pigeon for some time, and finally he promised it on a specific date. He wouldn't say in what room it would appear, explaining that "I have to take a run and a long leap, and I can't tell where I'll land." F. H. connects this statement with an assumed fourth-dimensional origin of the manifestation. The actual arrival of the pigeon was not observed, but it was found on the dining room floor. The bird was wholly calm, though his very recent arrival was indicated by the fact that, after being picked up, he left droppings at regular intervals; whereas no such indications of his prior presence were found anywhere. He was of the carrier type, with an identification band inscribed "1921 R. I." The attempt to trace the bird through this number reveals only the fact that he is not the one to which it was originally issued; it is quite common for pigeon fanciers to transfer identification plates from dead registered birds to live unregistered ones! All the windows and doors leading out of the house were examined after the pigeon's arrival and were found closed. Since this, Chester has several times brought objects upstairs from other parts of the house.

The control appears to have the clairvoyant powers which might naturally be associated with his alleged status. He has indicated that he knew the contents of pockets and other containers, once describing the currency in F. H.'s wallet better than the owner could do himself. On another occasion a late comer was expected. An automobile was heard in the street but the door-bell was silent. Chester said "He has come in a taxi, looked in the window, and gone away. He has on a fur coat and looks like a woolly bear." Though expected in his own car, he had behaved as described, through breakdown followed by uncertainty regarding the house; and the description of his appearance was amply verified when he ultimately was directed to the house and came in.

At least twice, Margery has quoted to me Chester's accurate repetition of remarks made about the mediumship and hypotheses advanced covering it, by investigators with whom I was in sufficiently close touch to permit verification from my own knowledge. In each case the inference or theory this retailed to me has been sufficiently obvious to suggest that Chester or Margery may be only a shrewd guesser; and sufficiently unobvious to prevent one from advancing this explanation with any degree of confidence. So I suppose I should feel at some loss to know just how freely I may discuss the case, *in camera*, with my committee!

Chester has a wide variety of curious sounds, aside from actual conversation. He describes these noises in terms which one takes as allegorical—the clanking of his chains, for instance. He laughs heartily, and in various tones. On one occasion, early in the sitting, I gave, for some reason, a deprecatory "tch, tch." Chester appeared to interpret it as the sound of a kiss; and he made it his own, repeating it from all quarters throughout the evening. In connection with the independent voice and whistling, Margery once took water in her mouth, retained it while these sounds were produced, then gave it back. The sitters were satisfied with the sufficiency of the amount taken in, and the correctness of that returned. On repetition, all those present participated in this test and still the voices came through.

Chester talks often of his tame bat, Susie, and presents sounds which are in good accord with his description of them as the fluttering of her wings. In my presence he placed the illuminated curtain pole diagonally, the lower end on the table and the upper leaning against the top of the cabinet. Susie then tobogganed down the pole repeatedly, climbing back again after each descent. She was represented to the eye by a faint luminosity, roughly the shape of a bat or butterfly. There was a swish as she shot down, rising in pitch until she hit the table; than a series of visible jerks and audible clicks as she climbed laboriously back. This decidedly hilarious manifestation was repeated again and again. On other occasions, it has been attributed to Chester's pet bear, Helen; as well as to other varieties of psychic livestock.

Recently Chester asked that a luminous plaque be supplied. On this he "writes" with the curtain pole or similar objects, the path of the "pencil" over the luminous surface being visible momentarily in an altered character of the phosphorescence. Each letter fades out as the next one starts. As the plaque lies on the table, it is Chester's habit to inscribe it with the names of the four sitters directly facing it, each name opposite its proprietor and in position as though written by him. The execution is rapid and the penmanship excellent.

Chester does not often give simultaneous phenomena, but whistling in two places at once, one by Chester and one by a specified assistant, is recorded; and his assistants are apt to monkey with the seance-room phonograph while he is doing something else.

F. H. was recently reading a book describing the mediumship of Stainton Moses, in which a dozen or so fundamental phenomena were listed, among them psychic odors. It struck him that here was one thing Chester hadn't done; and the oversight was made good at the next sitting. An interesting item of this character occurred when one of the sitters likened Chester's psychic touch to that of a powder puff; instantly an appropriate perfume was noted by several of the sitters. The circumstances suggest the inference that this was subjective, but the sitters are positive that they thought of this at the time and rejected the possibility.

Well; I have just mentioned the classic case of objective mediumship, and the case, after Margery's (or, perhaps, before hers), in which the moral probabilities are at their best. By way of graceful conclusion, I can do no better than rest on this comparison. Taken at its present face value, Margery's case is strikingly parallel to that of the British clergyman, and obviously deserves to have the same detailed and studied consideration which his would have if he were now living. In our August issue we shall start the story of how it is getting such consideration at our hands.

The Structure and Identification of Coal

PROFESSOR H. G. Turner of Lehigh University has recently announced a method for the determination of the structure of, and incidentally for the positive identification of, anthracite coal.

Although geologists have been fairly sure that hard coal was formed like soft coal from plants which grew in remote geologic ages there was no direct confirmation of their surmises until Professor Turner announced his invention. Soft coal had been sliced into minute sections thin enough for light to pass through and had been subjected to a microscopic examination which showed definitely its vegetable origin, but this method had been impossible for use with anthracite because no matter how thin it was cut it was still absolutely opaque.

Professor Turner found that by first giving the surface of the coal a fine polish, then drying it thoroughly at a temperature somewhat less than red heat, and finally heating the polished surface in the flame of the blowpipe or Bunsen burner to a dull red heat for a few minutes, it was possible with a microscope to see the structural details of the coal. The final heating burned away some of the coal, leaving a sort of skeletonized surface or etching. This was then observed through the microscope by a beam of light reflected from it, showing with great fidelity the structural details.

Photographs have been taken which show absolutely the vegetable origin of the coal. Some pieces resemble fragments of modern wood such as the maple or pine, while others show a pithy structure like bamboo or weeds, but unlike most of the trees of the present day. Spores of the great tree ferns of the far-away days when the coal beds were being formed have also been found.

An interesting part of the discovery lies in the fact that in most of the samples there has been no deformation of the cell structure such as would be caused by great pressure. Geologists have thought that hard coal was formed by the heating of soft coal under pressure. Professor Turner's results do not confirm this theory in so far as pressure is concerned. There is evidence that the coal has been heated, but none that it has been compressed.

A practical application of Professor Turner's invention is expected to be in the new means for identification of different coal beds. Operators lease particular beds for mining, and it sometimes happens that through twisting, breaking or pushing up or down of strata, there is much doubt and confusion as to just which bed belongs to which company. Professor Turner has found that the coal from different beds has marked differences of structure, having been formed from plants which, while they are of the same geologic epoch, nevertheless grew perhaps at intervals of thousands of years.—*Abstract from Science for August* 10, 1923.

Printed

"Like Stepping into Brilliant Sunshine"

No less important a paper than the Chicago Tribune recently commented editorially on the Westinghouse installation of "Octagonal Jr. Tops with Bi-lux Refractors" on Sheridan Road, Chicago.

Reproduced from unretouched photograph of Sheridan Road, Chicago

SAID the Tribune, in part, "Walking or driving these winter evenings out of the normal street lighting into this section is almost like stepping from a darkened room into brilliant sunshine. * * * * * It is something new in Chicago * * * * * The new light throws the rays where they are needed, instead of allowing them to go to waste in the air.

"The result is a street evenly illuminated with equal visibility between the standards and immediately around them, no glare in the eyes of motorists and pedestrians, but ease, comfort, and safety to all concerned. It is to be hoped that any further development of street lighting in Chicago will do as well."

The Bi-lux Refractor is responsible for this new and better street illumination. It bends part of the light which radiates in wasteful directions, and re-directs it where it will be more useful to pedestrian and driver.

The Westinghouse Illuminating Engineering Bureau will gladly furnish additional information.

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